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(The Kinds of Plants)

By L. H. BAILEY

11. The Cultivated Brassicas
Second Paper

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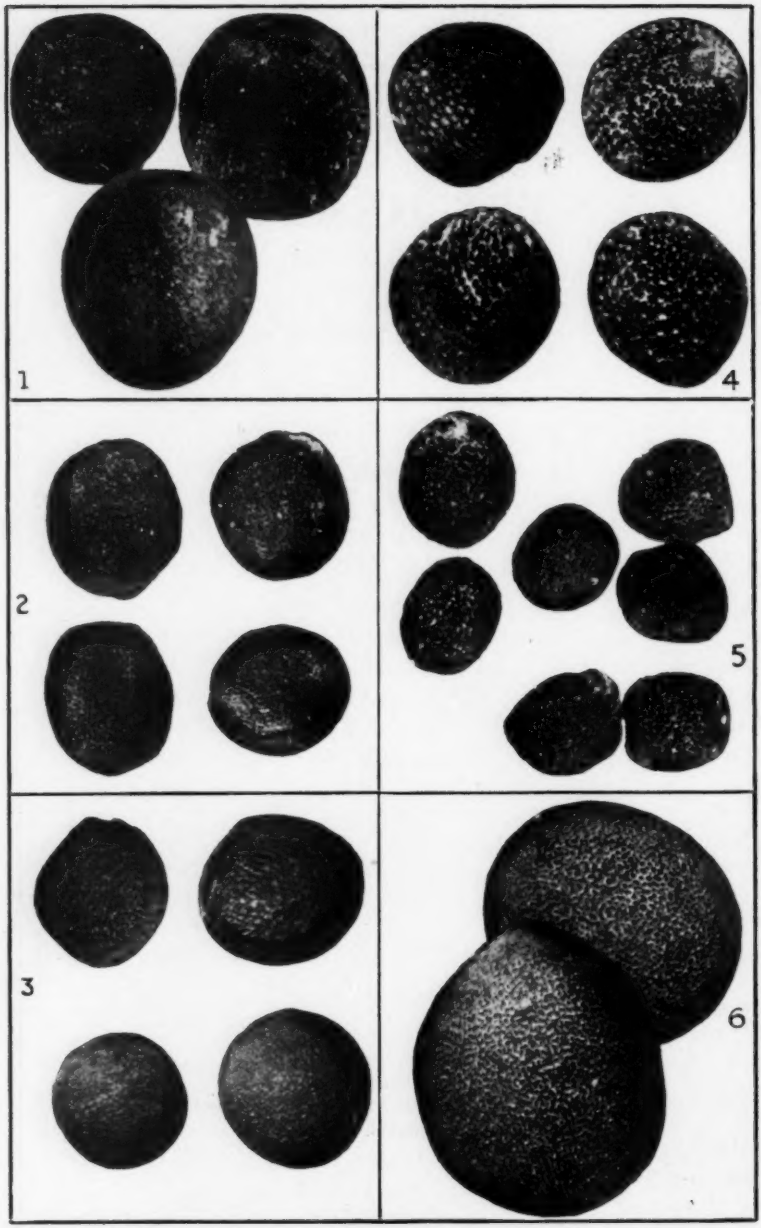

FIG. 108. SEEDS OF BRASSICA (× about 15).—1, *Brassica oleracea* wild above, lower one var. *capitata;* 2, *B campestris*, wild; 3, *B. Rapa* var. *septiceps;* 4, *B. juncea* two right wild, two left var. *foliosa;* 5, *B. nigra;* 6, *B. alba.*

See page 216.

Ex
Mrs. H. Bailey
12 - 1930

ARTICLE 11. THE CULTIVATED BRASSICAS SECOND PAPER

Eight years ago I published a paper on such cultivated Brassicas as I had then grown and studied, representing the conclusions of more than thirty years of attention to the subject (Gentes Herbarum, i, fasc. ii, Dec. 18, 1922). Since that time the interest in the group has been maintained; and inasmuch as the edition of the paper is now nearly exhausted it is necessary to prepare an epitome of it together with new observations.

The plants herein discussed are those named in Brassica and Sinapis, comprising the coleworts and the mustards. In the former paper reasons were given for uniting Sinapis with Brassica, the main one being that I do not know to which group many of these plants should be assigned. I still feel that if we are to divide them we should not stop with two genera; but I yet see no compensations in having more than one for the plants herein discussed.

The utilities of the species of Brassica to human beings are not likely to be understood in any one country because the uses are so regional. Brassicas of one species or another are raised for fodder, for green leaf-food, as dried, salted and preserved foods, pickles, krauts, accessories to meat dishes, as tubers, for oil from the seed, and for table mustard from the seed. Familiar with the kales, cabbages, cauliflowers, turnips, rutabagas of Europe and North America, one is not prepared for the sowings of mustard in eastern Asia as if they were fields of wheat. The young herbage is employed extensively in food, often, as I have seen it, fresh as gathered. Forbes and Hemsley in their enumeration of Chinese plants note that "one variety of *B. juncea* is cultivated in immense quantities, and, after drying in the sun, is pickled and eaten with rice." The cabbages of the Chinese are of a wholly different type from those of Europe and North America and have developed from a species-stock that is undoubtedly native in that part of the world. So extensively are the mustards grown in parts of southern Asia that Dr. Prain (Sir David) took up a study of them to determine their botany, and the excellent paper was published by the Department of Land Records and Agriculture of Bengal, 1898 (A Note on the Mustards Cultivated in Bengal, Bulletin no. 4, 78 pp., 2 maps, 10 plates). Several of the species of Brassica yield oil-producing races. Details of the utilities of these plants will appear in the notes as we proceed.

Table mustard is made from ripe seeds of species of Brassica. There are distinct types of it. In England, mustard flour is stirred up mostly

with water, occasionally with milk, by the housewife as wanted. On the Continent a table mustard is generally made by mixing or grinding either the ground seed or flour with vinegar, and such spices or other condiments as are chosen for flavoring. In the United States, "prepared mustard" forms the great bulk of the table product and is made by finely grinding the entire seed with vinegar, and such ingredients as are desired, to a smooth consistent paste. The consumption of table mustard in North America is surprisingly large.

The ~~becoming~~ common prepared table mustards are made, as reported, from the seeds of *Brassica nigra* and *B. alba*, usually blended, although *B. juncea* is also frequently employed. All three seeds have a characteristic "bite" when first ground, but this gradually disappears with age. *Brassica arvensis*, occasionally used as an adulterant in the past, has no bite. Government standard for mustard is as follows: "Mustard flour, ground mustard, 'mustard,' is the powder made from mustard seed with the hulls largely removed and with or without the removal of a portion of the fixed oil. It contains not more than 1.5 per cent of starch, nor more than 6 per cent of total ash."

The charlock, *Brassica arvensis*, is not discussed in this paper as it is not a cultivated subject, although I have grown it as "California rape" (perhaps an admixture). The plant is an abundant early-flowering weed of waste places and grain-fields, introduced from the Old World.

Most of the seed employed in North American manufacture and consumption is imported from Europe and consists chiefly of *Brassica alba* and *B. nigra*. A small quantity of mustard seed is home grown. An appreciable, and at times a very considerable, quantity of *B. juncea* is imported from the Orient. The Fourteenth United States Census (1920) reports mustard seed grown in California, Ohio, Kansas, Tennessee, Montana, the total product having a value in 1919 of only $106,011 of which $94,635 was produced in California. The total pounds was 3,168,370. The imports into the United States of unground or seed and ground (or prepared) mustard had a value of $2,034,000 for the year ending June, 1930; the pounds of unground or seed mustard were 20,273,000 and of prepared or ground mustard 1,788,000. The importations have apparently increased more or less with the population.

Seeds of Brassicas introduced by the Office of Foreign Plant Introduction of the United States Department of Agriculture (reported in this paper as FPI numbers) have been sent me for several years and I have grown the plants with a view to identification. This has brought an interesting range of material from different countries, particularly China and Japan. At the same time effort has been made to study such commercial coles and mustards as are novel or present difficulties in botan-

ical identification; and correspondents have made requests and supplied specimens. I have also had the advantage of seeds and information supplied by The R. T. French Company, Mustard Street, Rochester, New York, with kinds of mustard and rape from several parts of the world. In these ways the herbarium collection has grown, always supplemented by observation of the living plants raised in the garden, and often with photographs.

The range of variation in such a collection is of course very great; and yet the identification of the material has not seemed to be so hopeless as one would infer from the literature and the general experience with the Brassica-Sinapis group. The first requisite in the actual study of the cases is to divest oneself of old opinions and prejudices and to start the subject largely anew and objectively. There are few groups of plants in which the study has been more confused by inherited notions and by the lumping of botanical races.

As pointed out in the former paper, we should (1) cease the effort to base a nomenclature of these plants on postulates of the origin of one kind from another, at least until we have critical proofs. Origin is quite another quest and must be preceded by clear identification.

In the second place (2) the supposition that turnips, rutabagas and other diverse domesticated races are proximate forms of *Brassica campestris* should be challenged as an approach to the taxonomy of the groups. Linnæus properly understood *B. campestris* as an annual weed of the fields (Gent. Herb. i, 66), and he did not relate the garden plants to it. DeCandolle referred to it only the rutabaga, of the common garden kinds. It is true that we do not know the origin of many of the cultivated races, but it does not contribute to clarity to attach them miscellaneously to *campestris*. Prain wrote of Bengal mustards in 1898 that "Sarson and Tori are certain to be misunderstood if their scientific names are used. Both are, as a rule, referred to *Brassica campestris;* and though no one who has ever seen the two plants growing side by side will venture to say that they are the same thing, it is not unusual to find them treated in botanical works as merely different varieties of one particular subspecies of *Brassica campestris*."

In the third case (3) we cannot depend on some of the old history or on the casual accounts of travelers or on vernacular names in the various languages or on the records of early interchanges of seeds. The seeds of all these plants are much alike; the plants themselves may be strikingly similar even though distinct. The variations are great under changing conditions and often in different seasons of the year. Thus Prain states that: "The cultivation of these plants has shown that the confusion amongst the Bengal mustards is largely an affair of names and state-

ments: as regards the plants themselves, there is little difficulty." I have found in practice that a vernacular name may comprise several things and that the same thing may have several vernaculars. Thus my correspondent, J. C. Liu of Yenching University, assures me that the names Pe-tsai and Pak-choi applied by us to different oriental Brassicas represent the same Chinese character, one rendering being in Pekinese dialect and the other in Cantonese; that is, two species have been distributed under one Chinese name. Moreover, one frequently obtains two or more species from one seed-packet or sample, the seeds having been unknowingly mixed. The histories and printed records are of course suggestive and often valuable, but one must be cautious in employing them as a basis of taxonomy and nomenclature. I have purposely omitted much of the old citation, because not certain of its significance; it is likely to burden the record and to lead to confusion.

Again (4) we should be willing to forego the satisfaction of supposing that all the puzzling coles and mustards are hybrids. Many of them can be crossed; I have made crosses myself; but I see little if any evidence that the usual cultivated forms are proximate hybrids or that hybridity is a present confounding factor in them. Hybridity between species in cultivated plants is likely to be manifest in relatively few individuals at any one time and to be recognizable by unusual combinations of characters excepting, of course, in those groups (as canna, philadelphus, gladiolus, aquilegia) in which an intentional manipulated effort has been made for a definite result in amalgamation. That is to say, hybridity is not often sufficiently in evidence under open-garden conditions to swamp the species. Whether hybridity played a prominent part long ago in the origins of the established races in Brassica I have no means of knowing; that subject is not pertinent to the present inquiry.

Once more (5) we should cease the effort to attach the Asian oriental cultivated Brassicas to the traditional European species unless on direct botanical evidence.

Finally (6) we simplify the problem considerably if we go back to the names, diagnoses and citations of Linnæus, and begin again. Some of these plants appear to be more confused in literature than in nature.

Even so, the conclusions of any writer as to taxonomic units in Brassica will naturally depend to a great degree on the particular material at his disposal. In such a group the next worker will disagree with the last. This may be disturbing to those who still hold to the last-century conception of species, but in the nature of the case it is to be expected and we are to make the best of it. The new worker, therefore, need feel few limitations except such as are imposed by his plants.

The present writer does not expect to review the Brassicas again in a systemologic way, as a group. In the intervening years the subject

has been approached as much as possible without the former paper in mind in order to obtain a new view on the subject. Now that the new evidence is assembled and the old work is reviewed, it is interesting to find the two accounts agreeing so closely. It is fair to say that access has been had to important herbaria, for which gratitude is hereby expressed; and the personal collection numbers upwards of 2,400 mounted sheets of Brassica.

The Brassica group is indeed perplexing, excepting Rubus the most bewildering I have attempted. These plants were not closely examined by botanists until they had become widely dispersed over the earth and had assumed unidentifiable disguises. The fascination of the problem is unlimited.

There exists a prejudice against breaking up old traditional groups and describing new species in them. This is well. Yet one is bound to consider the plants and the testimonies they bring; if biogenetic races are not recognized systematically then no one can understand the groups. The domesticated Brassicas have been difficult enough in a botanical systematic way because not critically studied; if now we dump the added races assembled from different parts of the world into the same old categories the confusion will be complete. Of course the origin of the species and varieties separated in these two papers is not stated; the question is not asked, because nobody knows the answer. We do not know the origins of the oldest recognized species, in the part of Brassica with which we are dealing. We are not here concerned with ultimates but only with evidences. Certain species long ago separated in Brassica have attained the general consent of systematists, until we now recognize somewhat dimly the genius of the genus. If the same criteria are applied to the study of a much wider range of material, other species must also be recognized even if one is in doubt about the genesis of them; or if the botanist is disturbed, he need not call them species. For myself, I prefer to speak of such groups, in many genera, as cultigens inasmuch as the traditional concept of species is not adequate to the situation and does not meet the problem. The groups separated independently and named should assuredly be distinct enough for good definition in a species sense; they should come true from seed; their separation should clarify the older groups or species from which they are separated. Beyond this I have no knowledge, at least nothing occult.

The botanical characters separating species of Brassica are not definite, any more than in Tilia or Sagittaria; yet there are certain dependable marks: stature; leaf shape and insertion; character of inflorescence; size and color of flowers; the pod, particularly valves and beak; seeds. How far anatomical and histological, cytological, genetical and chemical studies may aid in clarifying species-lines is yet to be learned; and as to

the bio-geography of cultivated Brassica we have before us an alluring and little-traveled field.

The characters are obscured if plants are grown out of their season. Most of the Brassicas are cool-season subjects. Some of them are grown by native peoples of milder climates as winter annuals or at high elevations, frequently sown in late summer or autumn; when sown in spring in the northern United States, with the rapid oncoming of hot weather, these plants may not develop their full characteristics. I have also found many of them to be disguised if grown to maturity under glass (Gent. Herb. i, 56).

Chromosome studies

Studies of chromosome number in species of Brassica have been continued through two seasons by Miss Ethel Stiffler, graduate student in Cornell University, under the supervision and direction of Dr. Lester W. Sharp. The studies are not ready for publication, but it may be worth while to indicate the method and the purpose of taking the material.

A primary necessity in chromosome studies if they are to have relation to systematology is to be certain of the identity of the plant and to make record of it. This is particularly essential in cultivated Brassica because (1) critical identification of the species is not common, (2) the plants have been modified under long domestication, (3) more than one species may issue from a named seed packet because of mixture of the seeds in threshing and handling. To safeguard the results, the chromosome counts were made only from chosen individual ticketed plants and these identical plants are preserved as botanical specimens.

Several seeds of each subject were chosen with care, a single seed being planted in a small pot; when roots had filled the pot, the plant was turned out and root-tips taken for fixing and imbedding; the same plant was then set regularly in the ground and when flower-buds appeared (if of flowering races) material was taken for pollen mother-cells; when the plant was ready, it was pressed for the herbarium and then mounted and filed with the other Brassica sheets.

Seed-coats under a lens

The configuration of seed-coats separates the plants discussed in this paper into four groups: (1) seeds without definite markings as seen with a simple lens, characteristic of all the coles and most of the species of mustard; (2) those with distinctly reticulated pits or foveæ, marking the junceas; (3) the rough-pitted small seeds of nigra; (4) the finely granular-pitted appearance of the large seeds of alba.

These surface markings are best seen through a hand-lens giving ten or more diameters. They are presented in Fig. 108, showing enlargement by fifteen times; this illustration is composed from photographs

made for me by W. R. Fisher, photographer in the Department of Plant Pathology in the New York State College of Agriculture at Cornell University, to whom I am under obligation.

The size of Brassica seeds varies between species but (aside from nigra and alba) quite as much within the species. Persons who have examined commercial samples of cabbage and other seeds have noted the variations in size. The shapes are often significant, but one must be sure of fully developed and ripened seeds before undertaking a study of this aspect of the subject, and it is not attempted here. Persons desiring to study the anatomy of seeds of Brassica and other plants will find aid in Winton and Moeller, The Microscopy of Vegetable Foods, New York, 1906; and C. O. Harz, Landwirtschaftliche Samenkunde, i, 926-943 (Berlin, 1885) should be consulted.

Of course all these seeds show characteristic surfaces under close magnification, and some of the patterns have been well figured. See the interesting work, S. Lund og Kjaerskou, Morfologisk-anatomisk Beskrivelse af Brassica oleracea L. B. campestris (L.) og B. Napus (L.), Copenhagen, 1885. The present purpose is only to indicate the gross features under a pocket lens as aids in rapid placing of species. It appears that there is considerable variation in seed-coat markings in plants named as *B. campestris*.

The chemistry of Brassica seeds

Inasmuch as the seeds of some of the Brassicas yield such marked commodities in condiments and oils inquiry was made of M. C. Albrech, chemist of the R. T. French Company, importers and manufacturers of mustard and other products, Rochester, New York, as to whether chemical analyses might aid in clarifying the systematic botany of the group. He is of the opinion that the chemical character of seeds follows the species-lines in Brassica especially as relates to the so-called mustard oils.

To determine the content in relation to identity would require the combined investigation of a competent organic chemist and a trained systematic botanist. The work would need to cover a period of years to eliminate seasonal errors and to allow of correlation with soils and climate. At least one pound of seed would be required for a satisfactory chemical analysis of any sample inasmuch as so-called mustard oil is generally under one per cent; this seed should not be an ordinary commercial supply because its botanical identity might be in doubt and it might be mixed as to species. For safe results the seed of each kind should be grown purposely from stock of known purity. An investigation of this kind is much to be desired not only as an aid in the monography of Brassica but also as a further contribution in the relation of chemical content to the identification of botanical species.

On the chemical character of Brassica products the following informal comments are taken (by permission) from letters written me by Mr. Albrech:

Brassica alba contains a sulfur compound, sinalbin, which when moistened with water produces sinalbin mustard oil, which is the "bite" of white mustard.

Brassica nigra contains sinigrin, which when moistened with water produces allyl isothiocyanate, the bite of black mustard. This content of the black mustard is around 92 to 94 per cent pure. Allyl isothiocyanate is volatile with steam, while sinalbin mustard oil is not, and this fact is employed to determine approximately the amount of black (or brown) and white mustard in an unknown mixture.

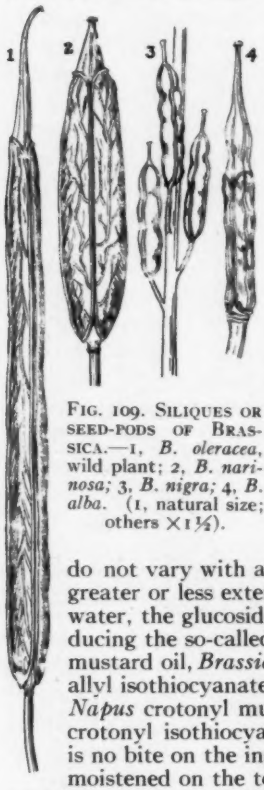

FIG. 109. SILIQUES OR SEED-PODS OF BRASSICA.—1, *B. oleracea*, wild plant; 2, *B. narinosa*; 3, *B. nigra*; 4, *B. alba*. (1, natural size; others ×1½).

Brassica juncea also contains sinigrin and produces volatile oil, the allyl isothiocyanate content of which, however, is appreciably less than that in the volatile oil of black mustard, the remainder being probably related compounds.

The rapes, in place of the glucosides sinalbin and sinigrin, found in mustard, contain a different glucoside, which when moistened with water produces crotonyl mustard oil, the "bite" of rape seeds.

We have examined a large number of samples of *Brassica alba* grown in various parts of the world, and we always find the same chemical characteristic, as noted above. In only one case do we seem to find more than a slight variation, and that is in seeds known as Russian or Caucasian. In these cases we found something apparently volatile and, figured as volatile mustard oil, ran from .04 per cent to .08 per cent. Other *Brassica alba* ran from .00 per cent to .03 per cent. The volatile oil of good black mustard seed generally runs around 1 per cent.

These compounds are essentially stable and do not vary with age. Mustard seeds also contain a ferment to a greater or less extent. When the crushed seeds are moistened with water, the glucosides under action from the ferment split up, producing the so-called mustard oils, *Brassica alba* producing sinalbin mustard oil, *Brassica nigra* allyl isothiocyanate, *Brassica juncea* also allyl isothiocyanate but not as pure as that from *nigra*, *Brassica Napus* crotonyl mustard oil which, however, is probably not pure crotonyl isothiocyanate. If one tastes crushed mustard seed there is no bite on the instant of first taste, but almost immediately it is moistened on the tongue the bite begins to develop. In analytical practice we allow the allyl isothiocyanate to develop two hours before distilling, although this volatile oil is probably all produced much sooner. I know of no quantitative method of determining the sinalbin mustard oil.

I do not know that any one has worked out the chemical composition of the oils produced from the glucosides in the various rapes and cabbages.

The taste (and flavor) of the bite of these various seeds is different from that of the three mustards mentioned and generally affords a quick way of distinguishing whether a given seed is a mustard (alba, nigra, juncea) or not. Probably in this great group of plants there is a tendency for the glucosides to modify and to produce slightly different compounds, the extent of which remains to be determined.

The Species of Cultivated Brassica

One of the early accounts of Brassica and Sinapis is in Lamarck's Encyclopédie Méthodique under the entries Chou and Moutarde. In the article Chou (cabbage-like plants), founded on the work of Duchesne, twelve species are entered, some of which are not now included in Brassica. Of the Brassicas proper with cylindrical beak on the silique, there are five species: *B. oleracea*, *B. asperifolia*, *B. Chinensis*, *B. violacea* (see remarks under *B. chinensis*, p. 253), *B. Cretica*. Six main subdivisions cover the forms of *B. oleracea:* (1) *B. oleracea arvensis*, much like the wild plant, cultivated for its oil-yielding seeds and leaves for forage; (2) *B. oleracea viridis*, the kales, of several kinds; (3) *B. oleracea capitata*, the cabbages, of which many kinds are listed; (4) *B. oleracea botrytis*, the cauliflowers and broccolis; (5) *B. oleracea gongyloides*, kohlrabi; (6) *B. oleracea napobrassica*, rutabagas; these categories follow closely the treatment of Linnæus. *B. asperifolia* is *B. Rapa*, including turnip.

An important arrangement of the Brassica cultigens is in Landwirthschaftliche Flora, Berlin, 1866, by Dr. Friedrich Alefeld (Lechdringhausen). 233-251. The Oleraceas are ranged under six large groups or primary divisions (Var.-Gr.: Varietäten-Gruppe): (1) *B. oleracea fruticosa*, Metzger; (2) *B. oleracea acephala*, DC., with many subdivisions; (3) *B. oleracea bullata*, DC., Wirsing or Savoy cabbages, of many kinds; (4) *B. oleracea capitata*, L., with subdivisions; (5) *B. oleracea caulorapa* (Alef.), kohlrabi; (6) *B. oleracea botrytis*, L. The Oleraceas altogether yield 57 Latin-named varieties. *Brassica Napus* comprises the two groups, *B. Napus oleifera*, DC., oil-rapes, *B. Napus rapifera*, Metzger, rutabagas, altogether with nine Latin-named varieties. *Brassica rapa* likewise is treated under two groups, with 22 varieties bearing Latin names, *B. rapa oleifera*, DC., oil-seed kinds, and *B. rapa rapifera*, Metzger, turnips. Other species in the Alefeld treatment are *Brassica nigra*, with five Latin-named varieties, and *Sinapis alba* with eight such varieties.

It is not necessary in this Fascicle to repeat from the former Fascicle the technical diagnoses of the species and varieties. The distinctions may be sufficiently understood from the contrasts in the key (beginning on page 220), from the informal remarks under the different kinds, and by the portraits.

KEY TO THE SPECIES OR CULTIGENS

§1. THE COLES.—Plants biennial or perennial or potentially so (unless no. 3), the foliage thick and usually succulent, glaucous-blue or blue-green (red in some horticultural varieties of cabbage): flowers large, nearly ½ to 1 inch long, light in color (from white to ochroleucous or very pale yellow); petals long-tapering into narrow bases; sepals mostly firmly erect and not spreading, often somewhat saccate at base: siliques large and long (Fig. 109, no. 1).

AA. Inflorescence elongated and open at anthesis, 5-10 inches long, not closely corymbose at apex: flowers large, to 1 inch (15-25 cm.) long, white or very light colored: young radical and heart leaves glabrous.

BB. Flowers mostly ochroleucous or creamy: biennial to perennial, largely with thickened edible parts, as stem or heads; plant producing directly a stock or caudex.

CC. Leaves large and prevailingly thick and succulent, some or all of those on stem sessile or clasping: stem not thickened into a tuber ..... 1. *B. oleracea*

CC. Leaves relatively small and thin, those on flowering stem slender-stalked: stem thickened above ground into a definite tuber ..... 2. *B. caulorapa*

BB. Flowers normally clear white: leaf-blade typically oval with a pair of auricles at base, long-petioled: plant annual, without thickened parts ..... 3. *B. alboglabra*

AA. Inflorescence short at anthesis, clustered or corymb-like at top and usually 4 inches or less long at blooming time: flowers smaller, mostly ½ inch or less long and commonly yellower: young radical and heart leaves bearing a few translucent setæ on ribs.

BB. Plant making a woody root, often a tap-root: prevailing stem-leaves oblong-lanceolate, toothed and notched but seldom lobed, mostly clasping directly or by means of a broad petiole-like base ..... 4. *B. Napus*

BB. Plant making at once a large deep durable ground tuber with a neck and rooting more or less from the lower sides: prevailing stem-leaves with large terminal lobe and 1 or 2 pairs of smaller lobes at base and often leaf-fragments on the petiole-like contraction, commonly clasping ..... 5. *B. Napobrassica*

§2. THE MUSTARDS.—Plants in many cases annual, not making heavy durable stocks or caudices and usually without tuberous-thickened parts except in nos. 6 and 14, the foliage usually thin and green or only superficially glaucous (except perhaps in no. 7): flowers small, ½ inch or less long, bright yellow or sulfur-yellow; petals less prominently clawed; sepals usually separating or spreading and not often saccate.

AA. Beak of glabrous silique or pod circular in section, not seed-bearing, slender or conical (Fig. 109, nos. 1, 2, 3).

BB. Mature silique terete and elongated, spreading or standing away from the axis of raceme.

CC. Ripe seeds with featureless coats (not prominently pitted or marked) under a good hand-lens, *B. Rapa* var. *septiceps* being partially exceptional (Fig. 108, nos. 1, 2): silique not torose.

DD. Some or all the stem-leaves clasping or amplexicaul.

EE. Root characteristically a large softish tuber without neck and roots only from under side (turnip), or heavy thick stock, plant potentially or actually biennial: stem-leaves mostly denticulate, variously clasping but not auriculate ..... 6. *B. Rapa*

EE. Root not a definite tuber: plants grown as potherbs or salads (or perhaps oil-seed in some countries), no. 7 with us known mostly as a weed.

FF. Plant mostly glaucous-green, annual: cluster of radical leaves not greatly developed or long-standing: some at least of stem-leaves auriculate (Figs. 128, 130) ..... 7. *B. campestris*

FF. Plant green or only slightly glaucous: cluster of radical leaves often greatly developed for domestic uses: stem-leaves not commonly auriculate although clasping.

GG. Main radical and lower stem-leaves long and narrow, very slender-petioled, entire, or a variety laciniate: annual and biennial ..... 8. *B. nipposinica*

GG. Main leaves broad, the radical ones with wide blades and stout thickened petioles.

HH. Petiole of radical and lower stem-leaves very broad, flat and tooth-winged (Fig. 132): annual ..... 9. *B. pekinensis*

HH. Petiole of radical and lower leaves thick but not prominently winged: biennial or annual.

II. Stem-leaves almost orbicular or at least very broad: silique thick and short, with short stout beak (Fig. 109, no. 2) .. 10. *B. narinosa*

II. Stem-leaves long and narrow, usually with expanded base: silique elongated and long-beaked (Fig. 136) ..... 11. *B. chinensis*

DD. Some or all the stem-leaves petioled or narrow-based, none clasping.

EE. Stem-leaves long and narrow: mostly annual ..... 12. *B. parachinensis*

EE. Stem-leaves elliptic-ovate or broader, at least the lower ones distinctly stalked (Fig. 140) ..... 13. *B. dubiosa*

CC. Ripe seeds prominently pitted or foveolate under a hand-lens (Fig. 108, no. 4): siliques torose (corrugated) or with strongly keeled valves and very short beak.

D. Root a turnip-like tuber: plant glaucous: main stem-leaves petiolate[1]. . 14. *B. napiformis*

DD. Root not tuberous or at least not turnip-like: plant green or only lightly glaucous: main stem-leaves various.

E. Silique torose, or torulose, and beak mostly long and slender . . . . . 15. *B. juncea*

EE. Silique little torose, the valves sharp-keeled and beak very short . . . . . 16. *B. carinata*

BB. Mature silique short and angled, closely appressed to rachis of raceme or parallel with it (Fig. 109, no. 3): seeds small, mostly angular, rough . . . . . 17. *B. nigra*

AA. Beak of hairy silique flat and knife-like, equalling or surpassing body, often bearing a seed (Fig. 109, no. 4): seeds very large, finely granulate or pitted under a pocket lens . . . . . 18. *B. alba*

1. **Brassica oleracea,** Linn. Sp. Pl. 667 (1753).
B. sylvestris, Mill. Gard. Dict. Ed. 8 (1768).

The wild native plant of the coasts of western and southern Europe.

The Oleracea plant is an erect often unbranched thickened trunk or caudex, bearing foliage along the sides and on top. Usually the year following seed-sowing the flower-stalks issue from the axils of present or previous leaves, and seeds are produced. A full-size pod of the wild plant is seen at No. 1 in Fig. 109.

The flowering of the domestic races is similar. If a cabbage plant is kept over winter and planted in spring, it goes to seed: flower-stalks arise from the old leaf-axils on the stump if the head has been cut off; if the head still remains it is customary to slit it crosswise to open it so that flower-stems may arise from the interior axils. Brussels sprouts behaves similarly. In cauliflower and broccoli the modified thickened flowers do not function as blossoms: new flower-shoots arise, as in the cabbage, from the old stump and from potential axils in such part of the head as may remain.

The wild *Brassica oleracea*, as I have seen and collected it at different times on the southern coast of England and have grown it, is a glaucous thick-leaved plant of various aspect. Often it is a compact simple clump of foliage from which the inflorescence arises apparently the second year; again it is 2 to 3 feet high, with a much branched woody stock apparently triennial. Sometimes the leaf-ribs are purple-tinged. It is described sufficiently in the former paper (Gent. Herb. i, 73). Mr. W. B. Turrill of the Royal Botanic Gardens, Kew, writes me that in his ground *Brassica oleracea* flowers for at least three years; necessary removal of the plants (which are tall branched individuals) prevent him from observing the full natural longevity.

Linnæus left no specimens to typify his understanding of the plant he called *Brassica oleracea*. The species was not founded on plants but on preceding literature. He indicated the plant as biennial and growing on the shores of England,—*Habitat in maritimis* Angliæ. This nativity was undoubtedly taken from Morison to whom he refers (Robert Morison, Plantarum Historiæ Universalis Oxoniensis, ii, 208. 1680), who recorded it as growing on the cliffs of Dover, whence it had been transferred to a garden, and also from Ray (John Ray, Historia Plantarum, 796. 1686) who also cites it from Dover and refers to Morison. Linnæus brings into his conception of *Brassica oleracea* (1753) the many named kinds of Brassica and Napo-Brassica of Caspar Bauhin, various cultigens, giving them Latin varietal names. From this taxonomic arrangement by Linnæus it has been assumed that he considered all the categories to be forms of *Brassica oleracea* of the coasts of England,—kales, cabbages, cauliflowers, even rutabagas and kohlrabi. If we go back to his Hortus

Cliffortianus (1737), however, we find he is unwilling to state whether one or more species may be involved.

From that day to this it has been mostly taken for granted that the kales, cabbages, brussels sprouts, broccolis, cauliflowers, are one species, derived from the plant that still grows wild on the shores of western Europe. The fact that Linnæus chose the wild plant of Morison and of Ray for citation and gives its habitat as maritime shows that he intended to make it the norm of his species *oleracea* rather than any of the ameliorated forms or cultigens; and this is further attested by his arrangement of the cultivated races as subordinates. The wild plant he designates as the *sylvestris* form.

In my former paper (Gent. Herb. i, 69) I wrote: "I follow the general assumption that the kales, heading cabbages and cauliflowers are derivatives of *Brassica oleracea* of the cliffs and shores of Europe. I know of no other source to which to ascribe them. Several times I have taken this plant in the wild and have grown it, but I have not observed variations suggesting the highly modified domesticated races; yet these races are apparently fairly within the range of possibilities of the wild species."

Perhaps one should not expect such suggestive variations to arise within the vision of the usual collecting and cultivating. But in the range of the domesticated plants themselves the attentive grower frequently finds kinds of variation that suggest a probable course of evolution. Knowing the character of the cabbage head, one is prepared for the development of axillary buds that make brussels sprouts; and not long ago the kitchen called my attention to a cabbage head that was made up entirely of several small lateral heads all completely inclosed within the usual outer leaves, apparently a real intermediate stage between cabbages and sprouts. The "buttoned" cauliflowers, the cabbages that fail to head and are practically kales, and other "rogues" and abnormalities, indicate that the development of these races is not yet fixed and that the forms are inter-related. The kinship of all these Oleracea groups is shown by the readiness with which they can be crossed. Yet the origin and evolution of the cabbage tribes are not understood. Much study of related native species is required, and the diverse regional developments of the great domesticated classes should be critically investigated. There may be surprises in the phylogeny. Origins of these plants are not determined by means of written history. Here is an archeobiological problem of the first importance.

In the present paper, however, we are not discussing origins: we are trying only to name and diagnose the main races and groups so that we may identify them. Harmonious botanical characters run through all these kale-cabbage-cauliflowers. The seeds are the same in their external

aspects; so are the pods, the flowers, the inflorescence; the leaves vary as between the groups but keep their larger essential characters.

It is impossible to represent the grades and kinds of variation of the syn-species *Brassica oleracea* in binomial and trinomial nomenclature, and it is not helpful to enter the fogs of quadri-and quinque-nomials. The plants defy all ingenious schemes: this makes them specially interesting.

The domesticated Oleraceas range themselves more or less satisfactorily into seven divisions:

I. The leaf-races, grown for the open foliage.
   1. Branching shrubby kales. *B. oleracea* var. *fruticosa*.
   2. Common biennial mostly unbranching kales. *B. oleracea* var. *acephala*.
   3. Low cabbage-like or Portuguese kales. *B. oleracea* var. *Tronchuda*.

II. The head-races, grown for the compact leaf-heads or buds.
   4. Edible product a terminal head, the cabbages. *B. oleracea* var. *capitata*.
   5. Edible product lateral small heads or buds, the Brussels sprouts. *B. oleracea* var. *gemmifera*.

III. The inflorescence-races, grown for the modified thickened flower-shoots or malformed flowers.
   6. Flowers only partially if at all modified. *B. oleracea* var. *italica*.
   7. Flowers thickened and malformed into a head or several heads. *B. oleracea* var. *botrytis*.

B. oleracea var. **fruticosa,** Metz. Syst. Kult. Kohlart. 12 (1833).
B. oleracea var. *acephala* subvar. *ramosa*, DC. Syst. Nat. ii, 583 (1821).
B. oleracea var. *ramosa*, Alef. Landw. Fl. 234 (1866).

BRANCHING BUSH KALES.—The *Oleracea-fruticosas* (shrubby) are stout plants enduring three or more years under good conditions, branching mostly midway or even lower, with more or less woody main stock or trunk, making a branchy bushy head 3 to 6 feet high. The plants I have in mind in reviving Metzger's var. *fruticosa* (J. Metzger, Systematische Beschreibung der Kultivirten Kohlarten, Heidelberg, 1833) are the cultivated forms covered by his *Brassica oleracea fruticosa hortensis* to the exclusion of his race *sylvestris* or the wild *B. oleracea*. The cultivated Fruticosas are probably least modified from the wild plant of any of the horticultural and agricultural races. The Branching and Thousand-headed kales or borecoles belong there. They are little known in the United States. Some of them are raised for human food, leaves being removed as needed. I have seen them growing in South American yards, for such purposes. They are also cattle-feeding plants.

B. oleracea var. **acephala,** DC. Syst. Nat. ii, 583 (1821).
B. acephala, Lév. Monde Pl. xii, 24 (1910).

KALES or BORECOLES, COLLARDS, of many races.—The *Oleracea-*

acephalas (headless) are the common kales or borecoles (borecole: *boer's cole;* that is, peasant's cole or cabbage). These plants differ from other Oleraceas in not normally making branching stems, more uniformly biennial, producing only open foliage and non-tuberous parts as the edible product. If leaves of the taller kinds are stripped and the winter climate is mild, the plants may persist three or four years and the plant may branch toward the top. Outside the common low curled kitchen kales, these plants are little known in the United States, with perhaps exception to be taken in the collards of the South, and thereby we miss a number of very desirable food products.

We may recognize three main groups in the Acephalas or true kales: (1) the *kitchen kales*, low plants, leaves oblong to oval to orbicular in outline, lobed toward base; common kales of the market, including plane-leaved and curled or crisped green and red varieties, such as Green Curled, Scotch Curled, Brown, Siberian. (2) *Tall* or *tree kales*, stocks 3 to 12 feet tall in developed retained plants, with heavy very glaucous leaves with rounded terminal part and more or less small lobing at the base toward or along the petiole. This class is best known in North America in the collards of the southern states; of this the young plants may be harvested entire, or leaves may be taken as wanted from overwintered plants which may become 3 feet and more tall. In densely peopled countries tree kales may be utilized as cattle feed, the leaves sometimes being removed as wanted and plants frequently not blooming till the third year; travelers know the Cow cabbage of the Channel Islands, which may become 10 feet and more tall and walking-sticks be made from the stocks. (3) *Marrow kales*, much like No. 2 but the trunk becomes thick and succulent, enlarging a short distance above the ground to the crown of leaves. This subrace is little grown in North America. It is prized in some countries as cattle-feed. (See Fig. 26, Gent. Herb. i, p. 76.)

† **B. oleracea** var. **Tronchuda,** var. nov.

Foliis magnis, crassis orbicularibusque, caput non formantibus, latis albisque costis et nervis.

PORTUGUESE, BRAGANZA, or TRONCHUDA CABBAGE or KALE. Fig. 110.—A low compact plant with very large and broad thick cabbage-like leaves that bear fleshy stalks and ribs and are aggregate into a terminal loose rosette-like part.

The *Oleracea-Tronchudas* (vernacular name) are much prized in Portugal. They make attractive plants much like cabbage except without compact heads but a bunch of leaves often with broad white ribs which may be eaten like Swiss chard. Seeds are offered in the North American trade as Couve Tronchuda or Portugal cabbage. A form of this kale is grown in Bermuda, where Portuguese have settled; more than 14,000

FIG. 110. PORTUGUESE KALE.—*Brassica oleracea* var. *Tronchuda*.

bushels of it were shipped to New York in the season 1929-1930. In Bermuda seeds may be raised from the current-year seedlings, but most of the seed is imported by the farmers from Portugal. The plant is used the same as cabbage, the herbage being cooked.

B. oleracea var. **gemmifera,** Zenker, Fl. Thueringen, xv, 2 (1836?).
B. gemmifera, Lév. Monde Pl. xii, 24 (1910).

BRUSSELS SPROUTS. Fig. 111.—The *Oleracea-gemmiferas* (bud-bearing) are Brussels sprouts, with only a few well-marked varieties or subraces. The sprouts or buttons are small heads an inch or two in diameter, borne along the side of the tall stem or stock. The main leaves of the Gemmiferas are commonly peculiar, being a short and rounded blade and usually with one or two rounded auricles or lobes near the base; the shape may be detected in young or seedling plants.

B. oleracea var. **capitata,** Linn. Sp. Pl. 667 (1753).
B. capitata, Lév. Monde Pl. xii, 24 (1910).

HEADING CABBAGES of many forms, including the Savoys. Fig. 112. —The *Oleracea-capitatas* (headed) cabbages are of two well-known horticultural groups: (1) The common plane-leaved kinds, and (2) the blistered-leaved or puckered kinds known as Savoys or Milan cabbages (the Wirsing of the Germans) and to Linnæus as *Brassica oleracea* var. *sabauda* (from the Latin name of Savoy). These groups are not essentially different botanically, although they may have had quite independent histories. There are also red cabbages; and a "glazed cabbage"

with shining bright green foliage and lacking the familiar glaucous-blue, has long been known.

B. oleracea var. **italica,** Plenck, Ic. Plant. Medic. vi, 29, t. 534 (1794).
B. oleracea var. *asparagoides,* DC. Syst. Nat. ii, 587 (1821).
B. asparagoides, Calwer, Deutschl. Feld. u. Gartengew. 183, t. 28 (1852).

ASPARAGUS, SPROUTING, ITALIAN BROCCOLI, in which the thickened flower-shoots are eaten. The plant sometimes called Italian kale in North America is very different, for which see *Brassica Rapa* var. *septiceps.*

The *Oleracea-italicas* (Italian) are open-topped two-season plants not producing a true head but rather prominently thickened flower-shoots that are cut for eating before the flowers open. The flowers may be normal and open in due season, and sometimes there are also clumps or knobs of aborted flowers much as in the Botrytes. The small leaves and bracts of the flowering branches are likely to be conspicuously toothed or even cut. This plant is considered to be botanically a primitive stage in the development of the cauliflower. It is little known in North America.

The colored plate of *Brassica oleracea italica* of Joseph J. Plenck, 1794, known as spargelkohl and brocculi, shows a plant with jagged-indented leaves, separate lilac-blue flower-buds not yet much separated in their short clusters together with open flowers appearing; detail drawings show regular racemes of flowers and pods. The flower character is very different from that shown in another plate for the cauliflower; there are no malformed or modified

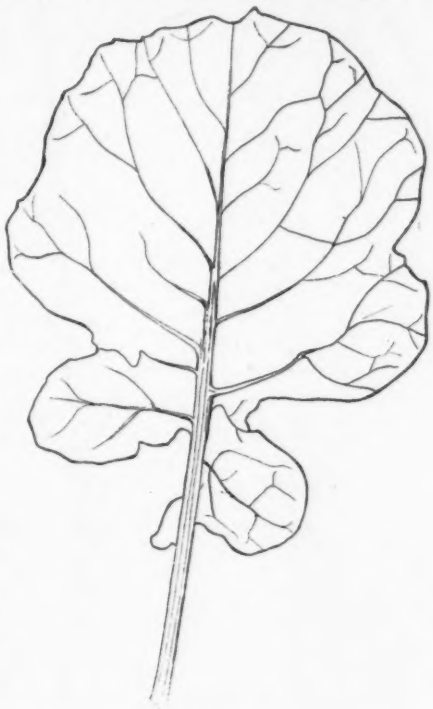

FIG. 111. BRUSSELS SPROUTS.—Characteristic leaf (×⅓).

flowers. In cauliflower the head is eaten, but Plenck states that practically the entire plant of spargelkohl above the root is utilized. Calwer in 1852 pictures the plant, obviously from Plenck, and describes it as spargelkohl (asparagus-cole). The blue coloring of the flower-buds in both Plenck and Calwer is questionable.

FIG. 112. CABBAGE.—Common form of leaf (× nearly ⅛).

B. oleracea var. **botrytis,** Linn. Sp. Pl. 667 (1753).

B. cauliflora, Gars. Explic. Sept Cents dix-neuf pl. 123 (1765).

B. botrytis, Mill. Gard. Dict. Ed. 8 (1768).

CAULIFLOWERS and BROCCOLIS. Figs. 113, 114, 115. — The *Oleracea-botrytes* (grape-bunch) are of two classes, cauliflower and broccoli. The cauliflowers produce a single terminal compact head formed of the condensed and consolidated fleshy flower-stems and thickened malformed flowers; the head is usually devoid of visible chlorophyll at maturity and is often further blanched by shading with leaves tied over it. The flower-axes are very much shortened, each inflorescence being compacted into one of the "curds" of the head; the bracts are apparent, although very small, as the curds are taken apart and also on the head itself, and the flowers are represented by the grains or papillæ that make up the surface of the head. The metamorphosed parts do not develop into normal or functional inflorescences and flowers. (See p. 222).

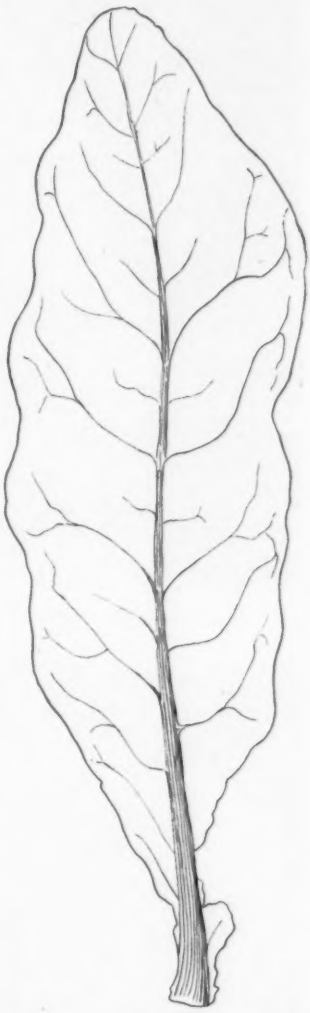

FIG. 113. CAULIFLOWER.—Shape of main leaves of the heading plant (× 1/5).

The broccolis commonly make a more or less branching top with several small heads. Usually there is a main central head and smaller lateral or ramose heads; when the central head is removed, the development of secondary small heads or hands is stimulated. In North America broccoli has been known mostly as a very late-maturing plant, in milder climates standing over winter and making some of the secondary heads in spring. Recently, however, a short-season race has been introduced from Italy under the name Calabrese and Glory of Calabria broccoli. Fig. 116. Its advertised date to maturity is 130 to 150 days, and should be handled to mature in cool weather.

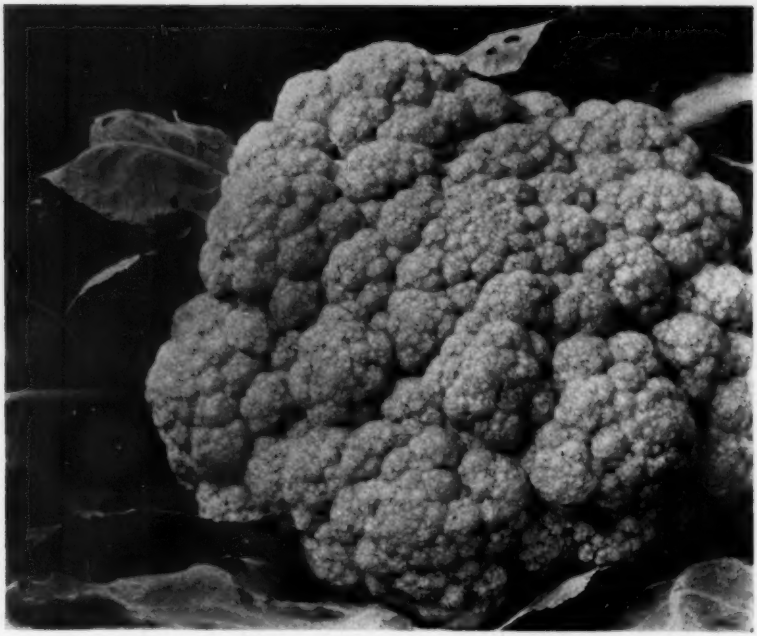

FIG. 114. HEAD OF CAULIFLOWER.—Showing the "curds" or separate malformed inflorescences.

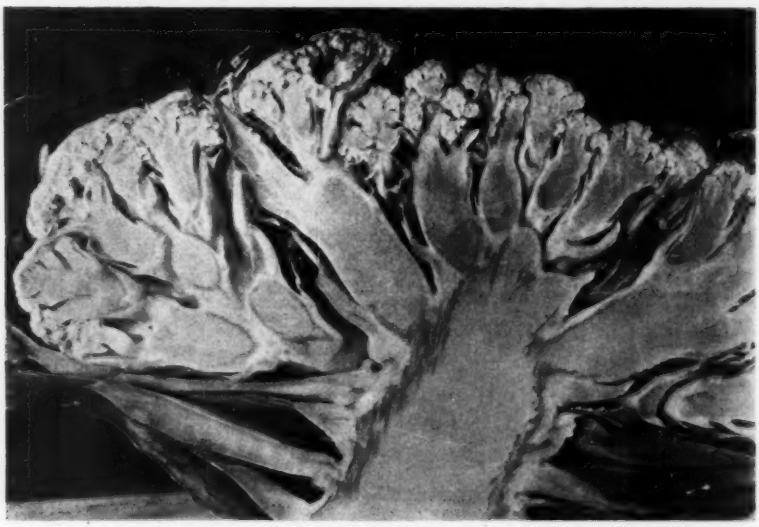

FIG. 115. CAULIFLOWER.—Up-and-down section of the head shown in Fig. 114.

It is now in condition in my garden as I write; seeds sown in the open ground the middle of April yield blooming plants in summer. Mr. Lee A. Somers, Assistant in Olericulture in the College of Agriculture of the University of Illinois, gives me the following dates: Seed sown in flats February 20 and placed in cool greenhouse; pricked out 2 by 2 inches March 4; removed to coldframe March 18; ready for field April 5 to 8 but because of unfavorable weather delayed until April 15; a few small weak heads from weak plants harvested May 23; first normal heads cut May 29; height of harvest June 15 to 18; last primary heads harvested July 10 to 12.

The Calabrese type of broccoli is intermediate between cauliflower and asparagus broccoli, and it might without great violence be classed

FIG. 116. BROCCOLI, SHOWING THE OPEN CLUSTERS OF MODIFIED FLOWERS. The Calabrese or Glory of Calabria (about ¾ full size).

botanically with either one. It produces small heads or buttons of undeveloped functionless flowers; later, regular flower shoots arise from the axils subtending these heads when the heads themselves have perished, and other more vigorous and fruitful shoots spring from other parts of the plant.

FIG. 117. KOHLRABI.—Stem tubers of *Brassica caulorapa* (× ½).

2. **Brassica caulorapa,** Pasq. Cat. Ort. Bot. Napoli, 17 (1867). Figs. 117, 118.

B. oleracea var. *gongylodes*, Linn. Sp. Pl. 667 (1753), but not *B. gongylodes* of Philip Miller (1768); *B. gongilodes*, Vietz, Abbild. t. 354 (1817) sine descr.—See Gent. Herb. i, 79.

B. oleracea var. *caulo-rapa*, DC. Syst. Nat. ii, 586 (1821).

KOHLRABI of the Germans and English; CHOU-RAVE of the French.—A well-known vegetable with nearly globular or oblong stem-tuber above ground, bearing leaves (Fig. 117); old stocks kept over winter (in the North) give bloom the following spring, one year or more from seed. The plant is well distinguished from all the Oleraceas not alone by the tuber but by the smaller stature in bloom, small coarsely dentate or jagged

long-petioled stem-leaves which are oblong or ovate rather than very broad in general outline, the petiole much expanded at attachment. The olericultural varieties fall into the two groups of green- and purple-herbaged. White Vienna and Purple Vienna are the leading kinds. Tubers become much elongated if allowed to reach full maturity.

Kohlrabi is not known as a native plant, and is assumed to be a cultigen. In Species Plantarum (1753) Linnæus did not describe his var. *gongylodes* (*gongylis*, classical name for a plant of this relationship), but his references to herbals sufficiently define it. The name *caulorapa*, *caulorapum* (stem-turnip) was known to the herbalists but not taken up by Linnæus.

FIG. 118. KOHLRABI.—Representative leaf (× about ⅓).

3. **Brassica alboglabra,** Bailey, Gent. Herb. i, 79, Fig. 29 (1922). Figs. 119, 120.

CHINESE KALE.—This annual white-flowered oval-leaved very glaucous plant with slender petioles I have grown under two names and Foreign Plant Introduction numbers since I described it eight years ago. It holds its characters well, except that two plants in one lot bore light yellow flowers, other plants yielding white ones. The leaves (Figs. 119, 120) have characteristic shape, with a pair of auricles at base of blade or on the petiole. I suspect that in mild climates the plant may maintain itself into the second year. In south China it is grown in the winter months.

In my first experience with this species (as originally reported) seeds sown in the open in April gave full-bloom plants July 1 and mature pods July 20. Subsequent cultures have not matured quite so rapidly, and plants have been in full vigor when overtaken by frost.

This plant gives no sign of thickened stem or rosettes. It maintains an open leafy growth 2 to 3 feet tall, with a single stem at base and is narrow-branching or forking above. It has a stiffer growth and thicker foliage than the mustards. The flowers are those of the Oleraceas. Recently I. H. Burkill in his interesting account of Malayan mustards (The

Chinese Mustards in the Malayan Peninsula, The Gardens Bulletin, Straits Settlements, v, 102. 1930) supposes that *B. alboglabra* is only a form of *B. oleracea;* this requires a very broad interpretation of *oleracea* and would naturally bring into it other confusing elements.

4. **Brassica Napus,** Linn. Sp. Pl. 666 (1753). Fig. 121.
B. campestris var. *Napus*, Babington, Man. Brit. Bot. Ed. 8, 31 (1881).

FIG. 119. CHINESE KALE.—*Brassica alboglabra* (about natural size).

RAPE.—Annual or plur-annual, surviving the northern winter if sown late or if it matures slowly, with a slender tap-root or even with branching roots but not tuberous; familiar in North America, particularly in the northern states and Canada, as a forage and cover plant, commonly sown in midseason or even later; Dwarf Essex rape may be considered one form of it as here interpreted. The word rape is variously understood, and it is probable that plants to which the name is applied in different parts of the world (including the oil-bearing races or colzas) are not all conspecific. Some of the stock known as rape is *Brassica campestris*, and some is *B. juncea* (note comment under *B. arvensis*, page 212). See *B. Napobrassica* for leaf contrasts.

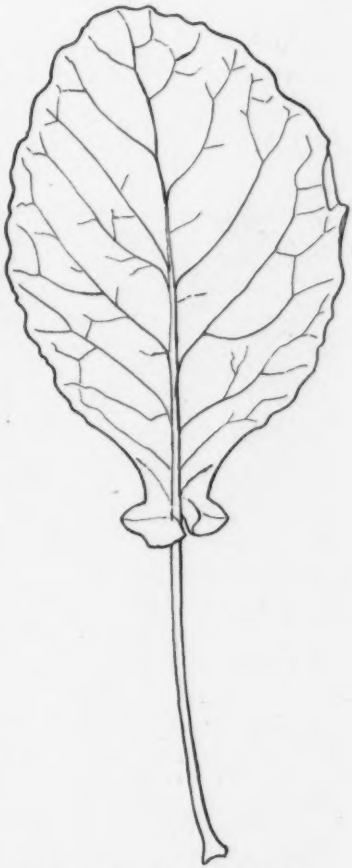

FIG. 120. LEAF OF CHINESE KALE.—*Brassica alboglabra* (× ⅛).

Authors may be expected to interpret this species differently. Nor can one be very clear as to the competent points of separation between it and *B. Napobrassica* (to which, indeed, the name is sometimes applied) except that the latter produces a durable edible root-tuber, although there appear to be rather uniform divergences in the leaves, particularly on flowering stems. Inasmuch as the species is Linnæan and as plants under the name of rape (or Napus) have a long previous history, it is advisable to recognize such a species at least until much further evidence accumulates.

The Linnæan conception of *B. Napus* is not clear. His diagnosis in 1753 is inadequate, and the citations may indicate different plants; therefore we must fall back on other evidences, as explained at some length in Gentes Herbarum, i, 67, 68, 81. The best of these evidences is his full characterization of the plant in Hortus Cliffortianus, to which he refers in Species Plantarum, and which is supported by a Cliffortian specimen in the British Museum of Natural History. This account calls

for a spontaneous rather than a domesticated biennial plant, growing among crops and along ditches in the Low Countries and England. Under such circumstances it would not be a rutabaga or turnip, and it is significant that he says nothing about the root. In the second edition of Species Plantarum in 1763, and the third edition in 1764, is a fuller diagnosis than in 1753, and again nothing is indicated about a plant with a developed or thickened root. He speaks of the calyx as mustard-like (proximus Sinapios). These various records point to the kind of plant known today as the agricultural rape, grown for forage and green-manuring and sometimes spontaneous (with seed-oil races referred to it); and the specimen of Napus in the Linnean Herbarium, so named by him although placed in the collection subsequent to 1753, supports this understanding of the species. This is essentially the plant understood in the early studies of Metzger (1833), omitting the var. *rapifera* (*B. Napobrassica*).

FIG. 121. RAPE.—Stem-leaves of *Brassica Napus* (× ½).

It now remains to discuss *Brassica napella*, Chaix in Villars, Histoire des Plantes de Dauphiné, i, 350 (1786), *nomen subnudum;* Villars, iii, 334 (1789). In Engler's Das Pflanzenreich (iv, 105, p. 49) Schulz refers it to *B. campestris* var. *autumnalis*, DC., although little account seems to have been taken of it in other works. Chaix and Villars meant to designate the Navette under the name *B. napella*. Villars cites the Nauete or De Napo of Dodoens, Pemptades, 674, as does Linnæus under *Brassica Napus*, which, however, is rutabaga or a similar plant. Napella is described as a form of the wild turnip: une espèce de Rave sauvage (and the Rave is

indicated as *Brassica Rapa*, Linn., interpreted as producing a round and depressed tuber). It was wild in the fields and grown in southern mountain valleys (Dauphiné, old province in the southeastern part of France) for the making of oil; sown after the harvest, it is mature the following June; there is also a variety sown in springtime but is less productive. It makes a hard wrinkled scarcely fleshy root. These various items suggest *Brassica Napus* as here understood, but an exact reference of it can hardly be expected. De Candolle in Journal of the Horticultural Society of London v, 30 (1824), did not definitely place it.

FIG. 122. RUTABAGA.—Stem-leaves of *Brassica Napobrassica*, Budlong variety (× nearly ⅛).

In this rape relationship probably belongs *Brassica præcox*, Waldst. & Kit. apud Schult. Obs. Bot. 131 (1809). It is kept as a distinct species by DeCandolle, l.c. 33, and is by Schulz referred to *B. Napus*. DeCandolle says it is not known to produce a fleshy and tuberous root, and "has long been cultivated by different farmers in various parts of Europe," being known as Summer rape or Navette. It is distinguished "by its upright seed-pod, which does not open when mature" and by its precocity; "it is usually sown in spring, and though it blossoms later than the Winter Navette, it has time to ripen in the course of the year, and is distinctly an annual." It is apparently the *B. Napus oleifera annua* of Metzger, Kultivirten Kohlarten, 45 (1833). I have not recognized this plant in any of my cultures.

5. **Brassica Napobrassica,** Mill. Gard. Dict. Ed. 8 (1768); Kerner, Oekon. Pfl. iv, 7, t. 312 (1791). Figs. 122-124.

B. oleracea var. *Napobrassica*, Linn. Sp. Pl. 667 (1753).
B. Napus var. *Napobrassica*, Reichb. in Moessler Handb. Gewächsk. Ed. 3, ii, 1220 (1833).
B. Napus rapifera, Metz. Syst. Kult. Kohlart. 46 (1833).

FIG. 123. RUTABAGA.—Natural-size flowers of *Brassica Napobrassica*, for comparison with Fig. 125.

B. campestris var. *Napobrassica*, DC. Syst. Nat. ii, 589 (1821).

B. campestris var. *napo-brassicata*, Prain, Bull. 4, Dept. Land Records and Agr. Bengal 46 (1898).

B. Napobrassica var. **solidifolia,** Bailey, Gent. Herb. i, 82, comprises the strap-leaved forms, not bearing deeply lobed or pinnate leaves.

RUTABAGA, BAGA, SWEDISH TURNIP or SWEDE; TURNIP-ROOTED CABBAGE of the English; CHOU-NAVET of the French; KOHLRÜBE of the Germans.—A well-known two-season plant producing large firm tubers employed extensively as human food and as stock feed. The tubers are distinguished from turnips (*B. Rapa*) by the long neck on which the leaves are borne and the roots springing from the lower part, as well as harder more durable flesh; roots are usually grad-

ually tapering downward, but some varieties are nearly globular; commonly the flesh is dull yellowish, but there are white-fleshed kinds. It sends up a single branching stem the second year, bearing seeds. In turnips the tubers are spent when the plant has flowered and fruited, but baga tubers usually remain alive and firm after flowering and sometimes they will produce stems a second time, remaining firm until winter. The tubers of bagas endure more frost than those of turnips. For these reasons bagas sometimes remain over winter in fields and become semi-persistent but I have not observed such behavior in the North on the part of turnips. The two species are readily recognized by the thick glaucous radical foliage of *Napobrassica*, the green lyrate setiferous leafage of *Rapa*, the large flowers and ascending calices of the former, which are nearly twice as long (⅜ to ½ inch as against ¼ inch or less) as those of the turnip, which have spreading calices. The flowers of *Napobrassica* are like those of the Oleraceas, those of *Rapa* like the mustards; the inflorescence of the former is much more long-racemose than in the other, as shown in Figs. 123, 125, also Fig. 124.

FIG. 124. FLOWERS OF TURNIP (left) AND OF RUTABAGA (two right).—Contrasts in size, all being enlarged two times. Rutabaga flowers are often larger than this: see Fig. 123.

The identity of *Napobrassica* of Linnæus and Philip Miller seems to be fairly clear so far as nomenclature and synonymy are concerned, although Miller actually described the kohlrabi in his popular account (see Gent. Herb. i, 83).

Of the varieties of rutabaga I have grown in the past forty years the following are represented by sufficient herbarium material for botanical identification and some of them by complete record of foliage, flowers, fruits as well as photographs: *B. Napobrassica*,—Bangholm, Blanc (French), Blanc lisse à courte feuille (French), Breadstone, Bronze-top, Budlong, Carter Imperial Hardy, Champion, Colson West Norfolk, Family, Imperial, Imperial Hardy, Improved American, Improved Purple-top, Improved Yellow, Jaune plat (French), Laing, Large White, Lincolnshire Improved Purple, Long White, Monarch, Ovale (French), Saint Andrews, Shamrock, Skirving, Sutton Champion, Sweet German, Taunton, White or Russian, White Cape, White-flesh, White-fleshed

Neckless, White French, Yellow-fleshed Neckless, Yellow French, Yellow Perfection. *B. Napobrassica* var. *solidifolia*,—Blanc hâtif à feuille entière (French).

6. **Brassica Rapa,** Linn. Sp. Pl. 666 (1753). Figs. 124, 125.
B. Rapa rapifera, Metz. Syst. Kult. Kohlart. 52 (1833), in distinction from the oil-seed races.
B. campestris var. *Rapa*, Babington, Man. Brit. Bot. Ed. 3, 24 (1843).

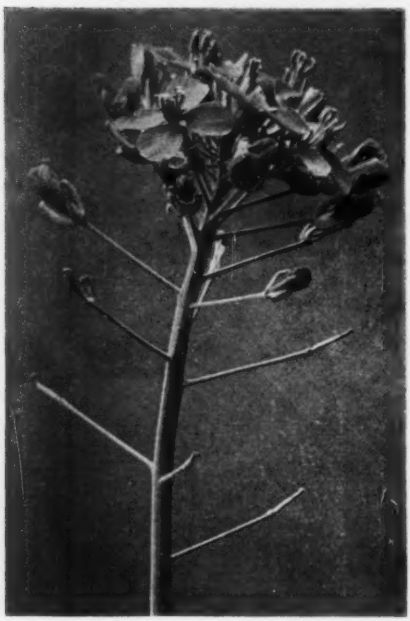

FIG. 125. TURNIP.—Natural-size flowers of *Brassica Rapa*, for contrast with Fig. 123.

TURNIP. RÜBE or SPEISERÜBE of the Germans, NAVET of the French.—A very different plant botanically from *B. Napobrassica* and at once distinguished by the contrasts stated under that species. There appears to be little doubt as to the plant Linnæus meant to designate as *B. Rapa* for two early cited pictures are in evidence. One portrait is the *Rapum vulgare* of Dodoens (Fig. 22, Gent. Herb. i), cited in Hortus Cliffortianus; another is *Rapum* in *Cam. epit.*, which is Camerarius' edition of *De Plantis Epitome Utilissima* by Pier Andrea Matthioli (1586) although a double tuber shown in the latter picture is peculiar.

B. Rapa var. **lorifolia,** Bailey, Gent. Herb. i, 85, fig. 34 (1922).

The strap-leaved races, with crown leaves not lyrate and little if at all lobed. The leaves of the second season, on flowering plants, do not differ from those of *B. Rapa* itself.

Turnips (by which is meant *Brassica Rapa* and var. *lorifolia*) produce tubers, in different named varieties, of many shapes and sizes, with white or yellow flesh. The flat turnips are popular in North America, but some kinds are nearly globular and others are tapering below or fusiform.

Varieties of turnips I have grown and are represented by more or less herbarium material are: *Brassica Rapa*,—Black Stone, Champigny,

Cowhorn, Early Dutch, Early Globe, Early Red or Purple Flat-top, Extra Early Purple-top Munich, Finland (New Yellow Finland, Yellow Finland), Freneuse, Golden Ball, Gray Stone, Green Barrel, Green Globe, Jersey Lily, Kashmyr, Large Yellow, Meaux, Montesson, Montmagny, Noir long (French), Petit de Berlin (French), Pomeranian (Pomeranian White Globe), Purple-top White Globe, Red-top Globe, Robson Golden Ball, Snowball (Early Snowball), Tankard (Long White Tankard), Teltow (German Teltow), True Jersey, White Egg, White Flat or Globe, White Model, White Norfolk, Yellow Aberdeen (or Aberdeen), Yellow Globe, Yellow Malta, Yellow Stone, also Japanese and Chinese kinds. *B. Rapa* var. *lorifolia*,—Early Pure White Milan, Red- or Purple-top (or -crown) Milan, Red- or Purple-top Strap-leaved, White Strap-leaved, White-top Milan, also Japanese kinds.

† **B. Rapa** var. **septiceps,** var. nov. Fig. 126.

Radice densa ligneaque sed non eduli, aliquot caulibus fere ascendentibus e caudice.

SEVEN-TOP TURNIP.—Root stout and woody, not edibly tuberous, surviving the winter even sometimes in central New York, usually sending up several shoots from the crown; these shoots supply potherb material or greens, much prized in some parts of the country: seeds usually finely but distinctly pitted or wrinkled under a good hand-lens.

The Seven-top turnip is an old garden plant, but I do not find that it has been definitely named botanically. It is so different in behavior from *B. Rapa* that I am in doubt whether to name it as a botanical variety of that plant or an independent species. It is grown in our middle latitudes as a salad plant and it becomes semi-spontaneous. In May this year I saw it blooming abundantly in old fields in Gloucester County, Virginia; a farmer told me that it is introduced with clover seed, and that the shoots make good eating in spring.

The plant has recently been much grown as "Italian kale" and sometimes even as "broccoli." Mr. W. W. Moore of Laurel, Delaware, writes me that the crop is sown in drills August 10th to September 1st on heavily fertilized ground, cultivated until frost; in early spring five to twelve sprouts are sent up from each plant, and if properly fertilized will run ½ to ¾ inch in diameter; these sprouts are cut above the crown when 8 to 10 inches high, tied in 1½ pound bunches similar to asparagus and packed for market 24 bunches to the crate. Seeds of Italian kale sown in my garden in June and July have made low turnip-like clusters of leaves for winter, with hard tap-root; the plants have stood out all winter, bloomed the following May and were in ripe pod in June. Except for the several or many stems from the crown, the septiceps plants in bloom look like the Rapa plants although the leaves of flowering stems

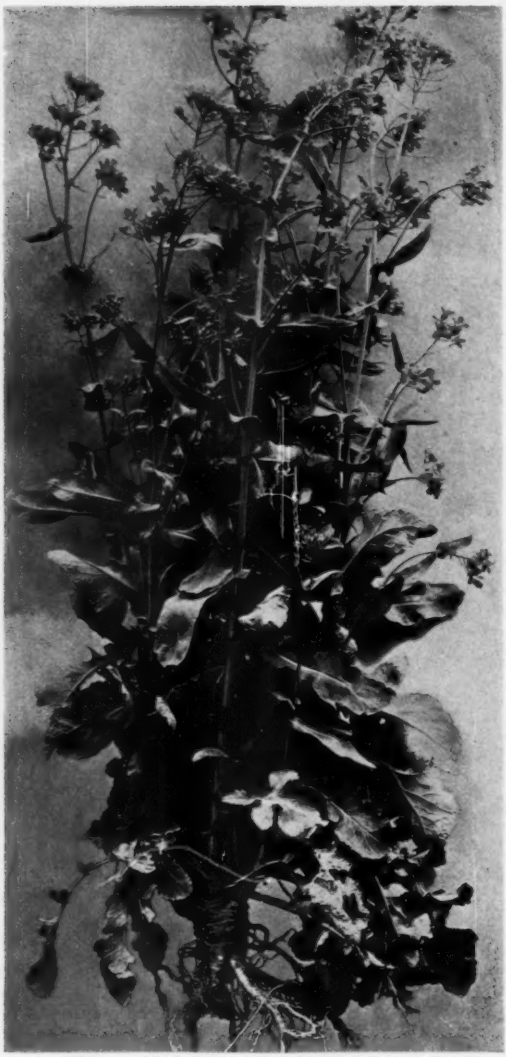

FIG. 126. SEVEN-TOP TURNIP.—*Brassica Rapa* var. *septiceps*. Plant 3 feet tall.

usually have less dentate margins. In some cases I notice only one stem from the crown, mostly when plants are crowded or soil not fertile.

We may now raise again the question of the Thames-side Brassica, an old inhabitant of the Thames river borders in England and which has long been a subject of speculation. In the preceding paper (Gent. Herb. i, 86) I discussed this puzzling plant on the basis of my own collections, and followed Hewett C. Watson "in supposing that it represents a feral form of the turnip species." If so, it is much like var. *septiceps;* the seeds are small, black, finely but prominently pitted, and in these respects as well as others differs from *B. Rapa* itself. The plant has other marks of its own, and it can probably best be clarified by treating it under some other and separate botanical name; such recognition might resolve a number of systematic difficulties.

The var. *septiceps* (and its associates) presents one of the most inter-

esting problems I have met in Brassica. Its relation to the domestic turnip opens fascinating inquiries.

† **B. Rapa** var. **perviridis,** var. nov. Fig. 127.

Foliis multis, magnis, non lobatis, glabris, saturate vitreo-viridibus radicalibusque; oleracea.

SPINACH MUSTARD. TENDERGREEN.—Differs from *B. Rapa* in the absence of a uniformly developed comestible tuber, glabrous foliage, basal leaves entire in main outline and bright glossy green on both surfaces as if glazed.

To those who know the plant now grown in the United States as Spinach mustard and Tendergreen it may seem violence to relate it closely in name with the turnips, and I am none too well satisfied with this disposition of it. The plant is apparently less related to other species of Brassica, and one hesitates to make a new species of it unless further evidence accumulates. The green-glazed not lobed foliage (Fig. 127) devoid of prickly hairs looks little enough like the herbage of turnip, but one is to remember that there is a green-glazed race of cabbages and that the strap-leaved turnips (var. *lorifolia*) have unlobed leaves; and there are other reasons for association with *B. Rapa*. as we shall see.

Plant annual, probably biennial in mild climates if sown late (winter annual), quickly making a clump of long tender fragile leaves very green above and lighter colored or somewhat glaucous underneath, the stem erect, to 6 feet tall in fruit, upwardly branched above. lightly

FIG. 127. SPINACH MUSTARD. —*Brassica Rapa* var. *perviridis;* one-third to one-half full size.

glaucous in the blooming stage: root sometimes straight, thin and hard (tap-root), more frequently a woody crown-tuber 1-3 inches diameter with roots from near the base: basal leaf-blades oblong to obovate, obtuse, green, glabrous and devoid of setæ, irregularly sinuate-dentate, tapering into a long narrowly winged petiole, total length 1-2 feet; stem-leaves sessile with a clasping and sometimes amplexicaul base, various in shape from long-oblong to narrow-lanceolate or in very late-flowering plants broadly ovate with large broad basal auricles, entire or obscurely sinuate: inflorescence elongated, the axial raceme to 2-3 feet long: flowers bright yellow, to ½ inch or more across, sepals narrow and open and scarcely saccate, petals with very broad obtuse blade: pods long and terete, the body about 2-2½ inches long and the slender tapering beak ½-⅝ inch long, all strongly ascending on slender divaricate pedicels: seeds dark brown, smooth (scarcely papillate under a good lens).

This plant has come into cultivation recently as Tendergreen. It was first offered under this name in the catalogue of Van Antwerp's Seed Store, Mobile, Alabama, in 1929, to take the place of spinach, turnip greens, kale and mustard greens. It produces the large radical herbage rapidly, being ready for home use, market or canning factory, according to the introducers, in 21 to 25 days after planting. Tests made at the Alabama Experiment Station and reported by Professor C. L. Isbell in Market Growers Journal, December 1, 1929, give olericultural details and favorable comparison with spinach, Seven-top turnip, and mustard. The sowings were made from November to April. In this report it is stated that the plant is sold recently by other dealers as Mustard spinach, Komatsuma mustard, Koatsuma mustard, Japanese mustard.

This mustard has appeared with me in two of the FPI cultures. No. 80582, *Uguisu Na, Komatsu Na*, Tokyo (Fig. 127), "said to be used like spinach," appears to be a good duplicate of the plant grown in the United States. No. 80934 is from Kyoto, Japan, where it has been supposed to be a cultivated form of *Brassica Rapa* or *B. japonica* var. *Suigukina*, Makino. The portrait of *Brassica japonica* var. *Suigukina* in Iinuma-Makino's Somoku-Dzusetsu (Vol. iii, part 12, pl. xxxii) does not represent the plant under consideration here. Both Tendergreen and FPI 80934 are growing in my garden as I write.

It seems that in Japan the plant is grown also for the root, which is pickled. In my cultures here of FPI 80934 the plants usually make a hard small turnip-like root, but some plants run only to a slender tap-root while bearing all the other features of tuber-bearing individuals. One plant that made a good very short tuber bore foliage quite unlike any of the others, something like turnip leaves but lacking the stiff translucent hairs of turnip. In FPI 80934 most or sometimes all the lower leaves are green on both surfaces but others on the same plant may be more or less glaucous underneath. Isbell (in Market Growers Journal) speaks of variation in Tendergreen, some "leaves resembling those of

Seven-top turnips." He also illustrates and describes tuberous roots. These various variations are in the direction of *Brassica Rapa*. In view of these facts and the evident botanical characters in seeds and pods I make the plant tentatively a taxonomic variety of the turnip species (*perviridis:* very green), rather than of *B. chinensis*.

Further information on Spinach mustard is taken from the inventory of FPI 80934, quoting Professor Namikawa: "The growing of this group is localized only in the vicinity of Kyoto in acreage of a little more than one hundred acres. The seed is sown at the end of September in rice fields after the rice is harvested and the soil well drained. Heavy manuring is required. The crop can be dug from the end of December to March. The salted 'Suigukina' is widely used and favored in 'Kwansai' district during the season. Occasionally it is also used after cooking. For making it into pickles, pack the roots, together with leaves, in a barrel, add some salt, and put a weight on it. When its juice is pressed out from the roots in a few days, pour the excess of it out and then add some more roots and salt. For a barrel containing about 16 gallons we use a peck of salt. In repeating the process the barrel becomes filled up. If the barrel is kept in a warm place the pickle matures in ten days. In a cool place it takes 3-5 weeks. The salted roots become agreeably acid when mature."

7. Brassica campestris, Linn. Sp. Pl. 666 (1753). Figs. 128-130.
B. Rapa var. *campestris*, Koch, Syn. Fl. Germ. 59 (1843).

FIELD MUSTARD.—An annual weedy more or less glaucous semi-succulent plant of old fields, grain lands, roadsides and waste places, native probably in Eurasia but now widely spread, known by its sessile auriculate-clasping central stem-leaves, stem usually purple at or toward the base. The plant seldom makes a long-standing basal tuft or rosette of foliage before the flowering stage. It varies greatly in size and leafage. Among grain or grass, or when thickly growing, it usually makes a narrow strict little-branched plant, but in open places it may be diffuse and much branched; sometimes in poor soil it is weak and low. On dumps I have seen it 3 to 4 feet tall, bushy-branched, with three and four stems rising from the crown and a tuber-like root 1½ inches thick. In California it is reported as attaining 6 feet. The basal and lower stem-leaves are variously lyrate on strong plants, but may be entire on small or weak ones. Fig. 129 shows well developed lower leaves, insufficiently seen in herbarium specimens. On very robust forms the leaf-blades may be 8 inches or more long and half as broad, tapering-lyrate toward base and with a long terminal lobe (Fig. 130). The plant is glabrous throughout except that a few setose colorless hairs may be present on the larger or

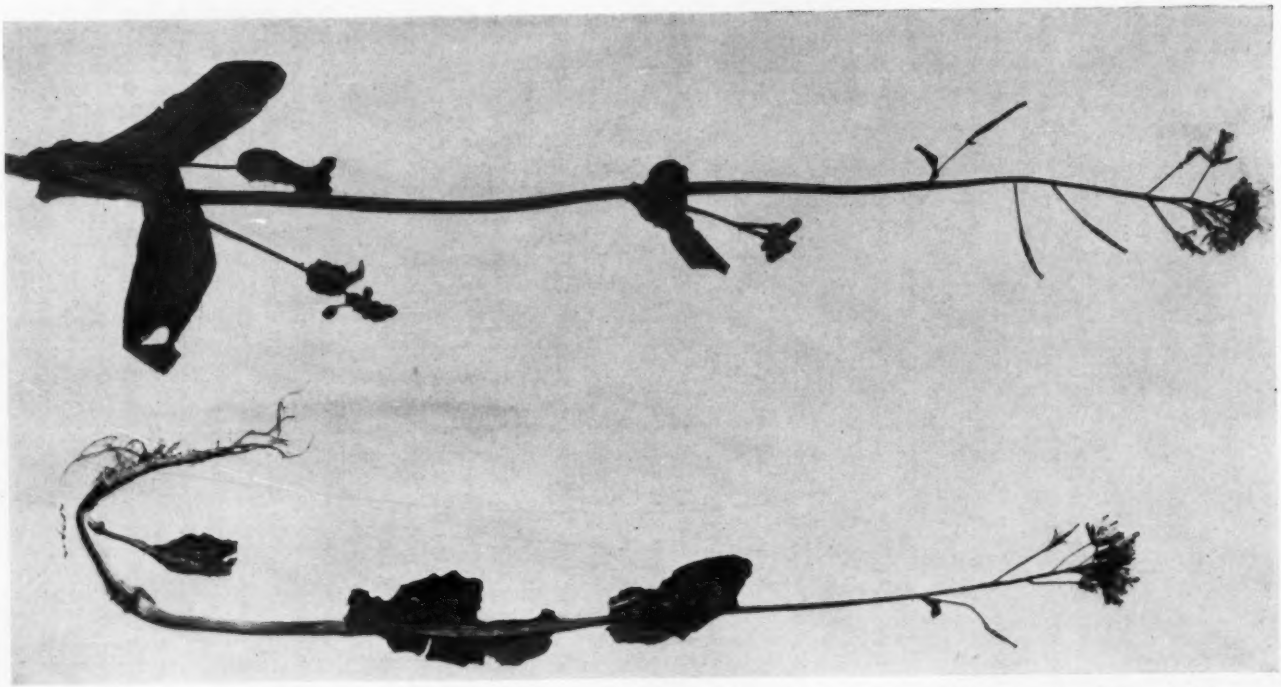

FIG. 128. BRASSICA CAMPESTRIS.—Linnæus' type sheet, preserved in London (Herb. Linn.), approximately three-fourths natural size.

lower leaves. Although of wide distribution in North America as a weed, some localities appear to be singularly devoid of it.

The Linnæan intention in the making of *Brassica campestris* seems to be clear because of references to a number of illustrations, one of which is shown in Fig. 21, Gentes Herbarum 1; there is also a specimen in his herbarium labelled *campestris* in his handwriting; Linnæus records the plant as annual with stem-leaves cordate and sessile. A photograph of his type specimen is shown in Fig. 128; it represents the small weedy plant of the fields.

FIG. 129. FIELD MUSTARD.—Basal leaves of *Brassica campestris* (× ⅓).

Some of the oil rapes are *Brassica campestris*, as stated in the literature. The species is scarcely known as a cultivated plant in North America, although I have grown it as California Spot mustard.

It has been widely assumed that the turnip (*B. Rapa*) is derived from *B. campestris* and this may be so; but knowledge of the subject is not

yet sufficiently advanced to justify a formulation in botanical nomenclature. The upper clasping stem-leaves of *campestris* are usually prominently auricled and entire or sinuate; leaves in similar position in *Rapa* are mostly not greatly auriculate and the margins are likely to be denticulate. The two plants have quite a different leaf character, although difficult to describe.

FIG. 130. FIELD MUSTARD.—Stem-leaves, half size, of *Brassica campestris*.

Under a number of names I have grown *Brassica campestris* from imported seeds, as Winter rape, Indian and East Indian rape, Argentine rape, Brown and Yellow Cawnpore rape (see also *B. juncea*), Bombay mustard (see *B. juncea* and *B. nigra*), and *Ta pai tsai*, Province Shantung, China, by Frank N. Myer (small). I have had it in the garden from India as Sarsing and Sarson (*B. campestris* var. *Sarson*, Prain); like many other mustards, this is a cool-season crop, and as it must be grown partly or mostly as a hot-weather crop in New York it does not develop its full character. I have raised it from India also as Rayo, probably a seed mixture for most of the material grown under that name is *B. juncea*. I have grown the Indian Tori, also a cool-weather plant; this is *B. Napus* var. *dichotoma* of Prain (*Sinapis dichotoma*, Roxb.) but have not yet been able to find distinctions between it and *B. campestris*.

† **B. campestris** var. (?) **purpuraria**, var. nov. Fig. 131.

Caulibus purpureis; foliis radicalibus, lyratis; inferioribus foliis caulinis, triangulo-ovatis ad lanceolato-oblongos; basi simili petiolo; superioribus foliis plus vel minus amplexicaulibus.

PURPLE MUSTARD.—Plant annual, very fruitful, with slender closely

erect-branching purple stems, 2-3 feet high, foliage often with purple ribs: radical leaves lyrate-pinnatifid, with broad veins and ribs that may bear a few translucent hairs: lower stem-leaves long-petioled, mostly triangular-ovate, entire or with a few fragments on the petiole: upper leaves narrowed to base or sessile, variously clasping and some of them auriculate.

This attractive plant I have grown since 1925. It is very distinct in appearance, but there is a variation and inconstancy in the foliage that make identification difficult and that suggest the behavior of *B. campestris;* and frequently the upper leaves are very like those of that species: therefore for the present I name it as a variety.

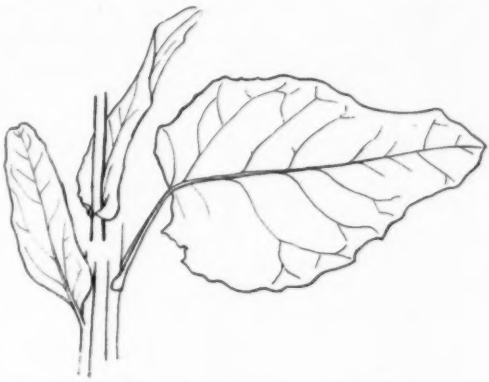

FIG. 131. PURPLE MUSTARD.—Stem-leaves of *Brassica campestris* var. (?) *purpuraria* (× ½).

The plant has come to me only from Chinese sources. FPI 63162, *Tze t'ai t'sai* (purple-stemmed vegetable), "a variety planted during any season and which matures in about 50 days" and "used chiefly by foreigners as greens;" FPI 63171, *Tze ts'ai hua* (purple vegetable flower), "planted during any season and matures in 60 to 70 days," and "used with meat and bean curd." I have herbarium specimens of it from the Peking market with the note that it is sold as a vegetable in spring, with petiole and stem purple; also from Nanking as *Dz tsai tai*, with purple stems and leaves, beginning to bloom on stems no longer than the basal leaves, used as a vegetable; and it is No. 7234 A. N. Steward, 1922, cultivated at Nanking.

8. **Brassica nipposinica,** Bailey, Gent. Herb. i, 86, figs. 35,36 (1922).
B. nipposinica var. **laciniifolia,** Bailey, l.c. 88, fig. 37.
B. japonica, Makino, Somoku-Dzusetsu, iii, fig. 33 (pl. 12), probably (1912).

In the eight years since I wrote the Brassica paper I have not received any new seed or any botanical specimens of this species and variety from any source. I have reared var. *laciniifolia* again, however, from old seed; the plants at winter had made a dense clump of leaves from June-sown seed, with a woody stock and no disposition to bloom. Plants did not withstand the winter, but they were at least potentially biennial.

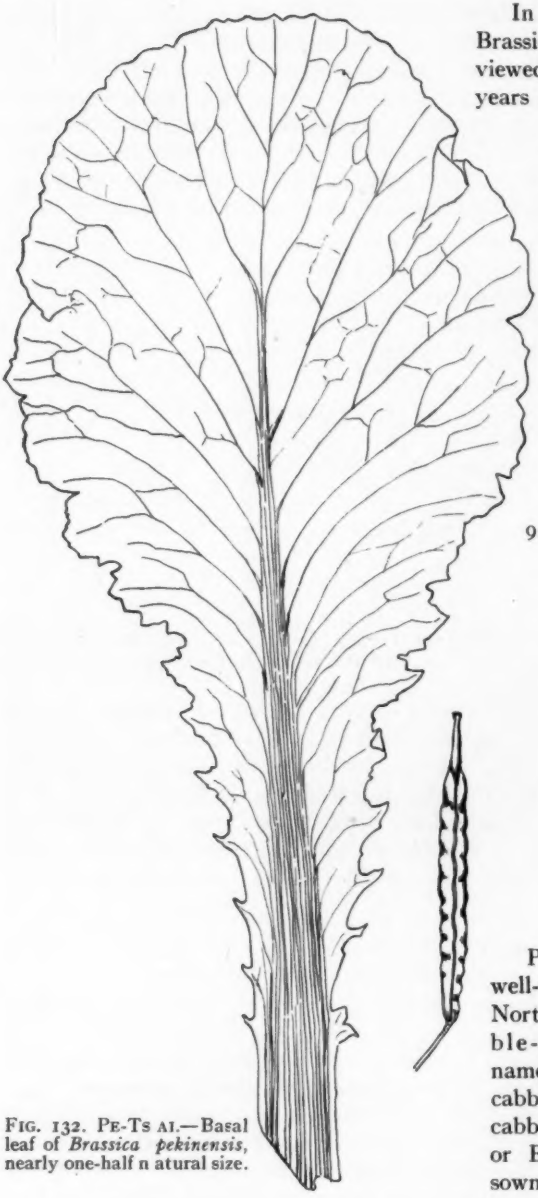

FIG. 132. PE-TS AI.—Basal leaf of *Brassica pekinensis*, nearly one-half n atural size.

In the many kinds of Brassica grown and reviewed in the intervening years I have found little suggesting *B. nipposinica*. It appears from present evidence to be a well-marked species, not grading into others. There are hints in it, however, that may disclose its relationships (*nipposinica:* Japanese-Chinese).

9. **Brassica pekinenis,** Rupr. Fl. Ingr. 96 (1860). Figs. 132-134.

Sinapis pekinensis, Lour. Fl. Cochin. 400 (1790).

Brassica Pe-Tsai, Bailey, Bull. 67, Cornell Univ. Agr. Exp. Sta. 178, 190 (1894).

PE-TSAI.—Now a well-established plant in North American vegetable-gardens under the name Chinese or Celery cabbage although not a cabbage in the traditional or European usage. If sown in spring the plant

is likely to run soon to seed, making only a loose basal clump of leaves; but if started after midsummer in the North, and treated like late cabbage, it should produce a compact head or cone of closely folded thin lettuce-like leaves with broad white stalks and ribs; it is often further bleached by tying up or wrapping with burlaps or other cover. It makes an excellent salad, or may be cooked like spinage or cabbage, and the blanched petioles may be utilized the same as Swiss chard. The plant is annual, distinguished by the green veiny basal foliage, flat broad feathered or tooth-winged petioles and clasping stem-leaves: pods 1-3 inches long, with soft veiny valves and a tapering beak; seeds of medium size, dark brown, without pits or reticulations. Yoichi Kazizaki has reported (Journ. Hered. xiii, 374, 1923) that flowers of Pe-tsai are 50 per cent or more sterile with pollen from the same plant but set heavily with pollen from other plants of the same kind. See also A. B. Stout, Cyclic Manifestation of Sterility in Brassica pekinensis and B. chinensis, Botanical Gazette, 73, 110-132 (1922).

We have no specimen to show what Loureiro (the Portuguese missionary) intended by his *Sinapis pekinensis* (1790) but his description and remarks point clearly to the plant herein described. His plant was cultivated at Peking, but was of inferior quality in Cochin-China, and it degenerated year by year when grown in Portugal.

FIG. 133. PE-TSAI.—Head of *Brassica pekinensis*, with outer leaves removed (×¼).

My oldest specimens of this species were raised by me in 1889 as Pe-tsai; in every succeeding year I have grown the plant or had it under observation. In my Bulletin 67, "Some Recent Chinese Vegetables," 1894, it is stated that the plant "began to attract attention in the United States probably about ten years ago;" it is there stated also that the plant, as Shantung cabbage, was introduced in England in 1887. From Kew seeds I grew Shantung cabbage as early as 1893, also Shantung Pe-tsai and Shakushi-na from Tokyo seeds in 1894. Similar plants were grown as Japanese cabbage or Santo-sai in 1890, 1891, 1892 from Japanese seeds. A variety called Luon, from Chinese gardens about New York, was grown in 1891; also *Pai-t'sai* from Tientsin seeds in 1894. I

have specimens also of cultivated plants collected in China under the two names *Kyan tshia* and *Wong ngah tshia*, and of material grown at Ithaca from various Chinese and Japanese sources; and specimens of cultivated plants have recently come to me from Peking under the names *Hsiao pai ts'ai* and *Kai ts'ai*. From French seeds it has been grown as *Pe-tsai amelioré* or *Chou de Shangton;* from North American sources as Pe-tsai, Wong Bok, and Celery cabbage. A good number of the FPI introductions belong with *B. pekinensis*.

FIG. 134. PE-TSAI.—Longitudinal section of head (× nearly ⅔); note that the stem or axis does not extend far into the head, as in common cabbage and in cauliflower (Fig. 115), but in elongated heads the axis is prolonged.

10. **Brassica narinosa,** Bailey, Gent. Herb. i, 99, figs. 44, 45(1922). Fig. 109, No. 2.

A well-marked plant, short in stature, succulent, making spreading or wheel-like rosettes of puckered ladle-shaped leaves with short broad flat petiole and widened ribs, bearing very broad often nearly orbicular clasping stem-leaves, short thick puffy veiny pods with very short broad beak (*narinosa:* broad-nosed), seeds dark brown and indistinctly roughened under a good lens.

The compact rosettes of radical leaves are to be seen in the winter and spring markets in China. I have taken it there under the names *Bah tshai, Ta khoo tshai, That koo tshai, Tshai hwo,* also *Sian tah khoo* under which name I have grown it also in China. Specimens have come from Peking as *Pai ts'ai*. I have had it in experimental cultures in this country.

11. **Brassica chinensis,** Linn. (Juslenius) Cent. Plant. i (1755), and Amoen. Acad. iv, 280 (1759). Figs. 135, 136.

B. Napus var. *chinensis*, Schulz in Engler Das Pflanzenr. iv, 105 (heft 70), 45.

PAK-CHOI or CHINESE MUSTARD.—Under the name *chinensis* are assembled forms of a very smooth biennial (or possibly potentially perennial) plant with large ladle-shaped upstanding radical leaves with thick ivory-white but not wing-margined or toothed petiole (but blade sometimes short-lyrate at base, otherwise entire), stem-leaves long and rather narrow and mostly clasping, large curved soft or puffy slender-beaked pods 3 to 4 inches long, and dark brown or yellow seeds indistinctly or finely pitted under a strong lens. In this country it has passed mostly under the name Pak-choi. It does not make a head like Pe-tsai or Celery cabbage, but the handsome leaves are used as mustard greens. Under several names it is much grown as a green vegetable in the Orient, and one finds the tufts of neatly tied leaves in the market in winter and spring. If sown with us in spring, the plants are likely to run rapidly to seed in the hot weather without developing the characteristic basal leaf-clumps.

FIG. 135. PAK-CHOI.—Plant of *Brassica chinensis*, after Prain.

As a species, *Brassica chinensis* is not very clear, as pointed out in Gentes Herbarum i, 99-102. There is no type specimen of the plant originally described by Linnæus' student, Juslenius, and a purple-flowered plant placed subsequently in Linnæus' herbarium and named by him *B. chinensis* is a Raphanus-like subject that is, said to be the Chinese *Brassica violacea*, Linn. = *Raphanus violaceus*, Crantz = *Orychophragmus*

violaceus, Schulz, although lacking the amplexicaul leaves shown in t. 5 in Loesener Beiheft Botanisches Centralblatt, xxxvii, ii (1919), and in specimens I have seen. On the sheet Sir J. E. Smith has noted that the specimens do not correspond with the description. The Linnæan account of *B. chinensis* is not sufficient but the Cynoglossum-like leaves, oblong and amplexicaul stem-leaves, and other characters are good marks of the plant we now understand as *B. chinensis* and there is nothing in the original history to prohibit the use of the name for the plant now under consideration. Prain adopts the name and keeps the species *chinensis* distinct, with one full-page plate (one part shown in Fig. 135) founded largely on the *Sinapis brassicata* of Roxburgh. The *Sinapis brassicata* of Linnæus is a *nomen dubium* (see Gent. Herb. i, 101). *Sinapis chinensis*, Linn. (1767) is a different plant from *Brassica chinensis*, Linn, and is referred by Prain to *Brassica juncea*, and by Schulz to *B. Urbaniana* (see under *B. juncea*, p. 261).

FIG. 136. PAK-CHOI.— Radical leaf (× ½) of *Brassica chinensis* and large pod (× 1).

The relationship of *B. chinensis*, as now interpreted, is with the *campestris* group. From *B. campestris* it is known at once by its biennial character (making a woody stock), lacking setæ or white hairs on midribs underneath, its yellowish-green foliage color in the flowering stage, the greatly developed radical leaves and petioles, stem-leaves much longer and bearing a broad rib and a different veining, the great pods, and unlike habit.

In China I have taken the plant in market or cultivation under the names *Sian zong tshia*, *Tshai hwo*, *Yeu tshia*, *Yeu*

tshia ho, and have grown it and received it from Chinese sources. From Japanese seeds I have raised what is apparently this species although not typical, and have collected it in Japanese markets. There are still herbarium specimens in my collection from the cultures of 1891, 1892, 1893, as *Bok toy moy*, *Choy toy moy*, and *Pak choi* from seeds obtained in Chinese gardens near New York City, of *Pak choi* from France, and Japanese cabbage with somewhat tuberous root shown in the illustration on page 184 of the Cornell Bulletin 67 (1894). It occurs also in several of the FPI numbers.

FIG. 137. MOCK PAK-CHOI.—Basal leaves of *Brassica parachinensis*, about one-half natural size.

12. **Brassica parachinensis,** Bailey, Gent. Herb. i, 102 (1922). Figs. 137, 138.

MOCK PAK-CHOI.—Distinguished from *B. chinensis* in the petiolate not clasping stem-leaves: radical leaves mostly with ovate or nearly orbicular blades and prevailingly smaller than in *B. chinensis*, the lower stem-leaves similar: central stem-leaves ovate to lanceolate to oblong, mostly petioled or at least narrowed toward base and not amplexicaul, passing at summit into narrow bracts; mostly a taller plant than *B. chinensis* at the blooming stage, with similar pods but seeds rather prominently pitted.

This mustard is apparently a prominent field crop in China. I have

FIG. 138. MOCK PAK-CHOI. —Radical leaf (× ⅓).

raised much of it from commercial seeds from Nanking, also seeds from Provinces Anhwei and Kwantung; also four lots from Frank N. Myer, then at Hankow, as *Chiang khan pai tsai, Hae pai tsai, Nan ching pai tsai,* and less positively as *Ya hao pai tsai.* I have also had it from experimental seeds in this country and have taken it as a cultivated plant at Port-of-Spain, Trinidad, British West Indies. It is probably widespread. Its genetic relationship to *B. chinensis* (and therefore to other species or cultigens) is yet to be determined. Nearly entire-leaved forms of *B. juncea* may be confused with this plant, but are distinguished by the green color, less glaucous character, narrow torose pods, pitted seeds, and other features.

13. **Brassica dubiosa,** Bailey, Gent. Herb. i, 102, fig. 49 (1922). Figs. 139, 140.

This species was proposed with considerable misgiving (*dubiosa:* full of doubt), but the separation was needed to clarify other species as well as to define this one. Since that time the plant has been grown from a new Chinese source and it presents its characters well. The species-name must, therefore, be retained until further evidence accumulates.

This dubious small mustard is apparently potentially biennial, at least if planted after midsummer, although seeds sown in spring bring forth seedful plants the same year. It makes a rather woody thin stock or root and a cluster of upstanding leaves 8 to 12 inches high; the blades are mostly obtusely lyrate at base and the lobes extending on petiole, turnip-like, sometimes bearing translucent hairs on stalks and ribs: stem-leaves very small, the lower ones more or less petioled and often prominently so, the upper ones narrowed to base but not clasping or at most only indifferently so: pods slender and long-beaked, strongly ascending; seeds small, dark brown, faintly pitted under a good lens. The plant with me has been practically simple-stemmed and 20 inches or less tall. To attach the plant to *B. campestris* or others would result in such an expansion of the diagnoses of those species as to be unwarranted in the present state of knowledge.

14. **Brassica napiformis,** Bailey, Bull. 67, Cornell Univ. Agr. Exp. Sta., 187, 189 (1894); also Gent. Herb. i, 83, figs. 31, 32.
Sinapis juncea var. *napiformis*, Paill. et Bois, Potager d'un Curieux, Ed. 2, 372 (1892); see also Ed. 3, 418 (1896).

TURNIP-ROOTED MUSTARD.—Differs from *B. juncea*, beside bearing a small turnip-like tuber and in being potentially biennial, in the glaucous-blue foliage, the lower developed stem-leaves oval in outline, coarsely dentate, with a prominent petiole that bears a few small leaf-fragments, the upper stem-leaves more likely to have a broad sessile base although not amplexicaul. The tuber may be as much as 4 inches in diameter, with a hard white flesh of a turnipy odor.

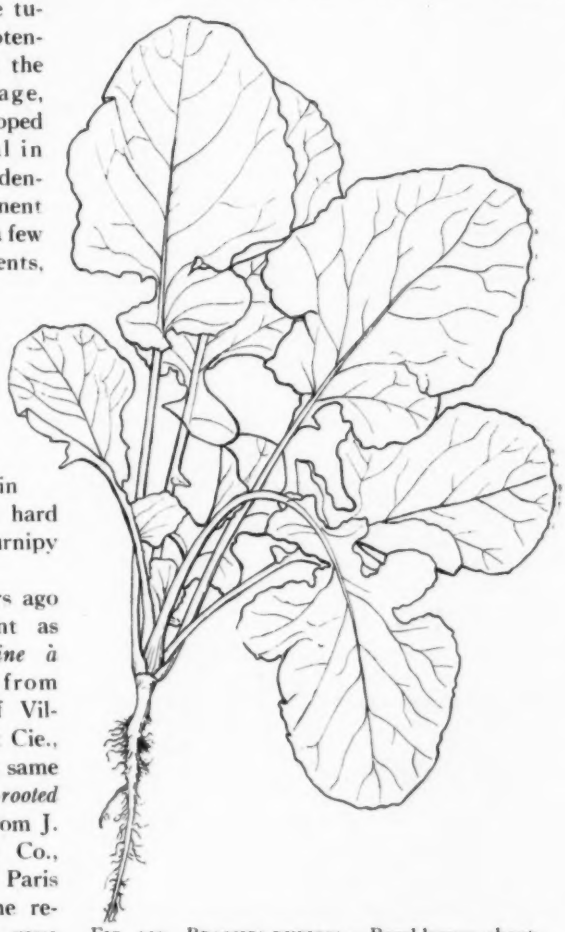

FIG. 139. BRASSICA DUBIOSA.—Basal leaves, about one-third natural size.

Thirty-six years ago I grew this plant as *Moutarde de Chine à racine tubéreuse* from seeds obtained of Vilmorin-Andrieux et Cie., Paris, and in the same year as *Tuberous-rooted Chinese mustard* from J. M. Thorburn & Co., New York. The Paris seedsmen write me recently that they gave up the growing of this mustard many years ago. Since those days I have not had a plant that satisfies the original account of Paillieux and Bois or appears to be the same as then grown, although I have raised several more or

FIG. 140. BRASSICA DUBIOSA.—Fruiting plant, about one-third full size.

less tuberous forms of *B. juncea*. The subject must await more definite information.

15. **Brassica juncea,** Coss. Bull. Soc. Bot. France vi, 609 (1859). Fig. 141.

Sinapis juncea, Linn. Sp. Pl. 668 (1753).

Sinapis integrifolia, Willd. Hort. Berol. 14, t. 14 (1806), or at least authors.

B. integrifolia, Rupr. Fl. Ingr. i, 96 (1860).

B. Besseriana, Andrz. in Trautv. Bull. Soc. Nat. Mosc. xxxiii, I, 134 (1860).

BROWN MUSTARD, INDIAN MUSTARD.—Usually weedy essentially green mustards without auriculate leaves, of wide distribution over the earth, supposed to be native in Asia; there are many horticultural races,

differing widely in leafage, stature and general appearance, but agreeing in certain features of leaf shape and attachment, pods, seeds, habit of growth. The systematic botany and synonymy of this species are not yet clearly understood. It contributes prominently to cultivated mustards in many parts of the world.

FIG. 141. BROWN MUSTARD.—Leaves of *Brassica juncea* wild (× ½), silique or pod (× 1) but often larger than this.

The particular brief marks of *B. juncea* are these: annual, glabrous, erect, becoming tall and branched, essentially green: main leaves broad, notched or serrate, often variously lobed at base: stem-leaves not clasping: pods ascending but not appressed, straight, long and narrow, not cornered, with slender beak, at maturity the placing of the seeds showing prominently and giving a corrugated appearance.—The plant is 2 feet or more high at normal maturity, weak subjects often little branched, strong specimens reaching 4 feet and much branched, not succulent, glabrous except sometimes sparsely setose-hispid on young leaves and stems or on veins underneath, essentially green (or yellowish-green) but sometimes thinly glaucous in the flowering stage: radical leaves in the wild plant not greatly developed and soon perishing, broad and obtuse, oblong or obovate, coarsely doubly serrate or dentate or notched, entire in outline or irregularly and oddly lobed particularly toward base and on petiole; lower stem-leaves similar, the upper passing into oblong or narrower toothed or entire bracts, petiolate or narrowed at base and not clasping: flowers small, yellow, crowded in anthesis at tip of raceme, calices narrow and spreading: silique thin-walled (not puffy), narrow, ascending, pedicelled, 1½-2½ inches long inclusive of the thin beak which is one-third or one-fourth the length of the body, prominently torose (corrugated or knobby) because of depressions between the seeds, valves with strong midvein; seeds medium in size, dark brown to yellowish, conspicuously pitted under the lens. Sometimes the plant singularly simulates *B. campestris*, particularly in small undeveloped forms, but is distinguished at once by the absence of auriculate-clasping stem-leaves and lack of the characteristic glaucous-green appearance of that species, and by the narrower more torose siliques and pitted or reticulated seeds.

While the striking variation may lie in the leaves, nevertheless the fruits show wide departures sometimes being so short and briefly beaked as to have much the appearance of Barbarea. Sometimes it develops a

hard caudex or crown as if it might endure a mild winter, at times becoming almost tuberous. Some of the more definable leaf-forms are presented in this account.

The Linnæan type of the species (*Sinapis juncea*) is an odd-looking specimen, and I supposed in my former Brassica paper (Gent. Herb. i, 95) that it represents "a pathological subject" with its slender clustered branches which probably suggested the name "juncea" (rush-like). Burkill in his paper on Malayan mustards (see pages 233-4 for reference) states that the Linnæan specimen represents the fascicled racemes that sometimes appear after the first flowering is past; I think he is correct; I have now observed these rush-like axillary growths, mostly late in the season and secondary, and have specimens that are a good match for the type material of Linnæus. It follows that Linnæus did not bequeath us an adequate conception either in diagnosis or specimens of this mustard; he apparently did not know the lower and the radical leaves.

The bibliography and synonymy of *Brassica juncea* are extensive: witness O. E. Schulz, Das Pflanzenreich iv, 105 (heft 70), p. 55 (1919). The subject would require a large pursuit for complete clarification. In the meantime we may discuss a few of the associated names.

The identity of *Sinapis cernua*, Thunberg, Flora Japonica, 261 (1784) may be considered in this connection. Schulz (l.c. 59) uses the name (as *Brassica cernua*) for the plant known in the present paper as *B. pekinensis*. Thunberg's description calls for a plant with white flowers, a singular circumstance in Sinapis (although the color may have been inferred from dried specimens), and cernuous floral branches. Photograph of Thunberg's type specimen at Upsala presents a large leaf, and part of a branching or compound inflorescence not yet in bloom (not the simple racemes of most species of Sinapis); the parts had probably wilted and drooped before being pressed. Juel in Plantæ Thunbergianæ refers the plant to *Brassica nigra*, accepting the disposition in Index Kewensis; the photograph is apparently *B. nigra*, although Raphanus has been suggested. The diagnosis is not sufficient for clear identification and the specimen should control.

The Roxburghian names in Sinapis have been variously interpreted. They are *nomina nuda* in his Hortus Bengalensis 1814 but are well described in the third volume of his Flora Indica 1832. Roxburgh left no type specimens, but excellent unpublished original drawings of most of them are at Kew and I have photographs of them. Even from these excellent portraits one hesitates to identify some of the species without first-hand field knowledge of mustards in India.

The rough-leaved mustard of Roxburgh has the following history in nomenclature: *Sinapis rugosa*, Roxb. Fl. Ind. iii, 122 (1832); *Brassica rugosa*, Bailey, Bull. 67, Cornell Univ. Agr. Exp. Sta., 191 (1894); *B. rugosa*, Prain, Bull. 4, Dept. Land Records and Agr. Bengal, 11 (1898) and considered as a subspecies of *B. juncea*, p. 47; it is a synonym of *B. juncea* by Hooker and Anderson in Flora of British India, and of *B. cernua* (that is, *pekinensis*) in Schulz, Das Pflanzenreich. Roxburgh emphasizes the broad midnerve of the very rugose leaves, that "beyond

the middle divides like the radii of a fan, which alone readily distinguishes this species while young from all the other sorts I have met with." The unpublished portrait brings out this character. The marks suggest *B. pekinensis* but in that species one does not see the peculiar lacerate leaf-lobing of Roxburgh's picture, nor the rugose character, and he describes and shows the floral leaves not clasping (they are so in *pekinensis*), the pod torose and seeds pitted. I am not able to place *B. rugosa* but it is apparently of the *juncea* group: see Gent. Herb. i, 93.

The branching mustard of Roxburgh, *Sinapis ramosa*, Fl. Ind. iii, 119, is referred to *Brassica juncea* by Hooker and Anderson, by Prain and by Schulz. The unpublished portrait seems to warrant this reference.

The wedge-leaved mustard of Roxburgh, *Sinapis cuneifolia*, Fl. Ind. iii, 121, is placed with *Brassica juncea* by Hooker and Anderson. It is *B. rugosa* var. *cuneifolia* of Prain, and is not placed by Schulz. Description and portrait associate it clearly with unlobed leaf-forms of *B. juncea* (*integrifolia*) that may occur frequently or from the same seed-stock as the lobed forms.

The spreading mustard of Roxburgh, *Sinapis patens*, Fl. Ind. iii, 124, is said by Hooker and Anderson to be a Nasturtium, on what basis I do not know; this course is followed by Schulz, who refers it definitely to *Nasturtium indicum*. Prain includes it under his *B. juncea* var. *agrestis*. The diagnosis and unpublished portrait indicate the unlobed leaf-forms of *B. juncea*.

The identity of *B. Urbaniana*, Schulz in Urban, Symb. Antill. iii, 3, p. 511 (1902-3), and in Engler Pflanzenr. iv, 105 p. 59, is in doubt, but so far as the West Indian plants are concerned it is evidently a form of *B. juncea* (see Gent. Herb. i, 93). His original citation of Arduini places the species with the Mediterranean *B. Tournefortii*, Gouan.

Forms of *Brassica juncea* I have grown under the following names and commercial or locality designations, the plants being sought for edible herbage, mustard-yielding or oil-giving seeds, and sometimes for thickened root-crowns:

Brassica Besseriana (with large seeds); Bombay mustard (see *B. campestris* and *B. nigra* also); Bold or Brown Cawnpore (Indian) rape (see also *B. campestris*); Chili mustard; Chinese mustard (mostly yellow seeds); Cochin (Cochin Chinese); Domeshie; East India rape (part of the stock being *B. campestris*); German Brown; Gujrat; Indian mustard or Rai; Japanese mustard (mostly yellow seeds); Japanese North; Kissock (Kissock Japan); Kutni (Indian Kutni); Manchurian rape (seed apparently mixed but my specimens are *juncea*); Montana Native mustard; Nan-Feng; Russian Brown; Takana or Oba-Karashina (probably var. *foliosa*); Yellow Mustard (Japan, China); and under several numbers of the FPI introductions, and others.

Next to *Brassica oleracea*, probably *B. juncea* is the most variable of the cultivated species of the genus. Its disguises are so many that one often has difficulty in finding characters common to all the forms. This is true even of wild plants, although naturally in less degree. From a

FIG. 142. LEAF-MUSTARD.—*Brassica juncea* var. *foliosa* (× ⅓).

wild *juncea* I grew plants a mile distant: the wild one had rather close small teeth on the leaves, and very short pods an inch or less long including the rather stout beak; the progeny bore leaves of twice the superficial area, coarsely notched, and the slender-beaked pods were 1½ inches long. From their general appearance one would not think the plants to be so closely related.

† **B. juncea** var. **foliosa,** var. nov. Fig. 142.

Cultigen; a *B. juncea* differt longissimis, stabilibusque foliis radicalibus et majoribus foliis caulinis.

LEAF-MUSTARD of cultivation.—Here are assembled the races that develop heavy great stools of radical long-standing leaves and also large lower stem-leaves, with margins coarsely and more or less obtusely toothed, used as greens or potherbs. The Chinese Broad-leaved mustard and other forms belong here. The radical leaves become 10 to 18 inches long and two-thirds as broad on good soil in the cooler parts of the year. The plant soon runs to seed in warm weather, but it is even then known by its abundant foliage and heavy growth. It is to this plant that the name *rugosa* has sometimes been applied (see page 260). It frequently persists for a time about plantations and buildings, usually even then well distinguished from the less foliaceous weedy *B. juncea*.

FIG. 143. PRONG MUSTARD.—*Brassica juncea* var. *longidens* (× about ⅓), pod natural size.

† **B. juncea** var. **longidens,** var. nov. Fig. 143.

Foliis angustis oblongisque, aliquot prominentibus, lateralibus magnisque lobis dentibus similibus.

PRONG MUSTARD.—Plant tall and robust: radical and main stem-leaves narrow, mostly long-oblong with more or less parallel sides, with several lateral long lobe-like teeth, single terminal lobe or finger often long and prominent; central or upper stem-leaves notched or coarsely toothed until passing to the usual narrow entire bracts: beak of silique (in the plants I have grown) short and stout, about ¼ inch long. Sometimes one or more of the leaf lobes are wanting or undeveloped, giving the blade an unsymmetrical appearance.

This striking plant, with its abundant lower side-pronged leaves one foot and more long that bear a few colorless spicules on the rib and veins underneath, I have grown as FPI 71291, *Luet lei hung*, from Anhwei province, China. Fig. 143.

The same or similar form, possibly to be referred to var. *japonica*, is FPI 71286, *Fa tsoi*, Anhwei province. Noted in Inventory No. 90 (1929) of the United States Department of Agriculture, stated as "a variety with crinkled leaves."

FIG. 144. CURLED MUSTARD.—*Brassica juncea* var. *crispifolia*.

B. juncea var. **crispifolia,** Bailey, Gent. Herb. i, 91, fig. 39 (1922). Fig. 144.

B. oleracea var. *sabellica*, Plenck, Ic. Plant. Medic. vi, t. 532 (1794).

CURLED MUSTARD.—Plant bearing much-cut and curled crisped lower leaves, popular for greens and somewhat for garnishing: upper stem-leaves sharply toothed or somewhat lobed, passing into narrow entire bracts.

Here belong the potherb mustards known as Ostrich Plume, Southern Curled and Giant Curled, California Pepper Grass, Fordhook Fancy. The plant sometimes persists about gardens. It is singular that this mustard has not been represented in the many kinds I have grown from

the Orient. I have taken plants that I have referred here in cultivation in China, and have received herbarium specimens from the Peking market, but they are apparently not the particular plant I intended in founding the var. *crispifolia;* they are less crispate and often have a different lobing. I do not feel justified to refer *B. cernua* var. *Chirimenna*, Makino in Somoku-Dzusetsu, iii, fig. 38, to var. *crispifolia*, for Makino's plant is not crispate.

B. juncea var. **japonica,** Bailey, Gent. Herb. i, 93, fig. 40 (1922).
Sinapis japonica, Thunb. Fl. Jap. 262 (1784).
Brassica japonica, Miq. in Ann. Mus. Bot. Lugd.-Bat. ii, 74 (1865-6); and Prol. Fl. Jap. 74 (1865-6).
Brassica nigra var. *japonica*, Schulz in Engler Das Pflanzenr. iv, 105, p. 79 (1919).

It has been supposed that the curled mustard of gardens (var. *crispifolia*) is the plant intended by Thunberg as *Sinapis japonica*, but Thunberg's plant is not crispate; it has irregularly cut-pinnatifid lower leaves with very narrow separated divisions, as disclosed by his type specimen preserved at Upsala. I have taken the plant in China as a cultivated subject and have grown it from French seeds under the name *Moutarde de Chine à feuille laciniée*. Apparently it is not in commerce in North America.

B. juncea var. **multisecta,** Bailey, Gent. Herb. i, 93, fig. 41 (1922).

A race with much more finely divided leaves than the other forms, being multifid with linear or filiform shred-like lobes. This variety has been seen only from plants cultivated in China.

16. **Brassica carinata,** Braun, Flora xxiv, 267-8 (1841). Figs. 145, 146.
B. integrifolia var. *carinata*, Schulz in Engler Das Pflanzenr. iv, 105, p. 58 (1919).

A distinct looking very seedful annual, marked by thick short-beaked keeled pods and thin petioled leaves. Erect, 3-4 feet, or diminutive specimens fruiting at 1 foot or even less, with many erect branches, glabrous or the ribs sometimes bearing translucent hairs, stems more or less glaucous and the main trunk commonly purplish: lower leaves with large oval lobe 3 to 5 inches long, shallowly sinuate-dentate, with small lobes at base and sometimes fragments on the long petiole, these leaves passing gradually into narrow upper cauline petioled or narrow-based variously dentate floral leaves and bracts: siliques 1-2½ inches long at maturity and sometimes ¼ inch thick, erect or strongly ascending, valves veiny, beak short, usually less than ¼ inch long; seeds rather large, brown to dark brown, prominently pitted.

This plant I grew as long ago as 1924 and it had remained without

name in the collection. It is FPI 58729 from Adis Abebba, Abyssinia. Seeds sown the middle of May have yielded plants in bloom in July and full of seed in late August and September. The foliage has somewhat the look of forms of *B. nigra*.

FIG. 145. AN ABYSSINIAN MUSTARD.—*Brassica carinata*, nearly natural size.

The Abyssinian plant I have grown is referred to the *carinata* of Alexander Braun on the basis of the printed descriptions of that species. For the most part the accounts well apply to it. Braun founded the species in his account of the cultivated plants of Abyssinia in 1841 (Die abyssinischen Culturpflanzen, in Flora). He states that the plant is not unlike *B. nigra* in habit, but Richard in his flora of Abyssinia, 1847 (Tentamen Floræ Abyssinicæ i, 22) relates it to *B. oleracea*. Braun's account of the keeled silique, equal in diameter in either direction, together with description of leaves, seem to leave no doubt however; and Schulz's diagnosis (as var. *carinata*), founded presumably on Braun's material and also on collector's numbers, further confirms me in this disposition of FPI 58729. There are also specimens from the collections of Braun in the National Herbarium, Washington, in fruit only, with which my material agrees.

17. **Brassica nigra,** Koch in Roehling Deutsch. Fl. Ed. 3, iv, 713 (1833).

Sinapis nigra, Linn. Sp. Pl. 668 (1753).

BLACK MUSTARD.—A well-known large annual weedy plant widespread in waste places, fruiting late, distinguished by its stem more or less hispid toward base, the bushy twiggy habit and branching inflorescence, and particularly by the short appressed angled siliques. Old World.

This species is grown for the seeds as a source of table mustard. Seeds are likely to be an admixture in other kinds of mustard; as such it has appeared in my sowings from Indian and Chinese seeds, and even

as Giant Southern Curled mustard. As a cultivated subject I have specimens under the designations Alsace (Noire d'Alsace), Bari, Black, Bombay (see also *B. juncea* and *B. campestris*), California Trieste, English Brown, Sicily (Noire de Sicile).

Black mustard is a various plant, in stature, leafage, in fruit and seeds. Several Latin-named varieties are recognized.

18. **Brassica alba,** Rabenh. Fl. Lusat. i, 184 (1839).
Sinapis alba, Linn. Sp. Pl. 668 (1753).

WHITE and YELLOW MUSTARD.—A well-known tall annual mustard more or less naturalized in North America, and grown for its mustard- and oil-producing seeds and sometimes for its young herbage used as salad. It is known by its irregularly pinnately divided leaves, more or less hairy character, abundant yellow fragrant flowers, spreading hairy pods with a knife-like beak equalling or exceeding the body, and large light yellow lightly pitted seeds; probably Eurasian.

FIG. 146. LEAVES AND FRUIT of Fig. 145, the former × ¼, the latter natural size.

I have grown *Brassica alba* under the names California Yellow mustard, Caucasian Yellow, Dutch Yellow, Moutarde blanche triée (French), Russian Yellow, White London, the last being the usual commercial variety.